

## APPENDIX A

The following table summarizes examples of microfluidic components and structures that can be made available in a library for design capture.

| Component/<br>Structure   | Brief Description  | Reference(s)                             | Figure<br>Number(s)     |
|---------------------------|--|--|-------------------------|
| ON/OFF<br>Switches        | An ON/OFF switch is open in the ON state allowing fluid flow therethrough and is closed in the OFF state to prevent fluid flow therethrough. |  |                         |
|                           | Pressure-actuated, normally open switch  | Present<br>Application<br><br>60/282,253 | 2A-3<br><br>7A-7E<br>8  |
|                           | Pressure-actuated, normally closed switch  | 60/282,253                               | 9A-9D                   |
|                           | Vacuum-actuated, normally closed switch  | 60/282,253                               | 10 & 15A-<br>15J        |
|                           | Inverted pyramid pressure amplification switch   | 60/282,253                               | 39A-39D<br>40-41        |
|                           | T-switch   | Present<br>Application                   | 13A                     |
|                           |  |  |                         |
| Valves                    | Valves are provided for directing fluid flow.  |  |                         |
|                           | Side-actuated valve  | PCT/US00/<br>17740                       | 48A-48B                 |
|                           | Unidirectional valve for permitting fluid flow in one direction therethrough   | 60/282,253                               | 20A-B<br>21<br>22<br>23 |
|                           |  |  |                         |
| Interconnect<br>Bridges   | Interconnect bridge having a control channel with tapered element for bridging a fluid channel   | Present<br>Application                   | 17B                     |
|                           |  |  |                         |
| Vias                      | Vias provided in one channel for bridging another channel.   | Present<br>Application                   | 18B                     |
|                           |  |  |                         |
| Tapers                    | Fluidic taper for facilitating connection between a larger channel and a small channel   | Present<br>Application                   | 28                      |
|                           |  |  |                         |
| Switchable<br>Flow Arrays | Switchable flow array including fluid passages that can be selectively directed to flow in two perpendicular directions                      | PCT/US00/<br>17740                       | 31A-31D                 |
|                           |  |  |                         |

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| Component/<br>Structure  | Brief Description  | Reference(s)                      | Figure<br>Number(s) |
|--------------------------|--|-----------------------------------|---------------------|
| Multiplexer              | Multiplexer having multiplexed channel flow controllers for directing fluid flow into one or more of a plurality of synthesis channels or chambers in which solid phase synthesis may be performed | PCT/US00/17740                    | 33                  |
| Gates or Gate Structures | Fluidic logical gates can be used to perform Boolean functions.  |                                   |                     |
|                          | Inverter for inverting an input to produce an output   | 60/282,253                        | 12A                 |
|                          | OR gate  | 60/282,253                        | 12C                 |
|                          | NOR gate   | 60/282,253                        | 12E                 |
|                          | AND gate   | 60/282,253                        | 12G                 |
|                          | NAND gate  | Present Application               | 5A                  |
|                          | Latch/Flip-flop  | Present Application<br>60/282,253 | 6A<br>6B<br>33      |
|                          | D-latch  | Present Application               | 7A                  |
| Amplifiers               | Fluidic pressure amplifier for amplifying pressure   | 60/282,253                        | 3-4B                |
| Pumps                    | Fluidic pumps are used for pumping fluid.  |                                   |                     |
|                          | Pump operating by compression and bending of fluid chamber   | 60/282,253                        | 17A-B               |
|                          | Peristaltic pump with multiple control lines for pumping   | PCT/US00/17740                    | 24A-24B             |
|                          | Rotary pump/mixer for mixing and incubating solutions  | Present Application               | 21                  |
| Capacitors & Reservoirs  | A capacitor or reservoir can be used for storing and releasing pressure.   |                                   |                     |
|                          | Single-chamber high-pressure reservoir   | 60/282,253                        | 24                  |
|                          | Two-chamber capacitor  | 60/282,253                        | 28-29B              |
|                          | Single-chamber vacuum reservoir  | 60/282,253                        | 32                  |
| Pressure Sources         | High pressure source for applying high pressure fluid to load devices  | 60/282,253                        | 26                  |
| Generators               | High pressure generator having stages for multiplying output pressure  | 60/282,253                        | 27                  |
| Vacuum Sources           | Vacuum source for driving vacuum-actuated devices  | 60/282,253                        | 30                  |

| Component/<br>Structure       | Brief Description  | Reference(s)                                     | Figure<br>Number(s) |
|-------------------------------|--|--|---------------------|
| Fluid<br>Chambers             | Selectively addressable reaction chambers provided along flow lines and in an array for selectively directing fluid flow into one or more of the reaction chambers | PCT/US00/<br>17740                               | 28A-30              |
| Switching<br>Regulators       | Switching regulator for performing analog functions  | 60/282,253                                       | 34                  |
| Sorting<br>Devices            | Sorting device for cell sorting and DNA sizing   | PCT/US00/<br>17740<br><br>Present<br>Application | 36<br><br>27-28     |
| Separation<br>Devices         | Separation device for perform separation of materials  | PCT/US00/<br>17740                               | 43                  |
| Cell Pen<br>Structures        | Cell pen array for storing materials within a selected, addressable position for ready access  | PCT/US00/<br>17740                               | 44A-44D             |
| Cell Cage<br>Structures       | Cell cage with pillars that permit opening of cage for transfer of cells   | PCT/US00/<br>17740                               | 45A-45B             |
| Cell Grinder<br>Structures    | Cell grinder with interdigitated posts that can be closed to crush material therebetween   | PCT/US00/<br>17740                               | 46A-46B             |
| Pressure<br>Oscillators       | Pressure oscillator for generating pressure oscillation  | PCT/US00/<br>17740                               | 47                  |
| Mirror<br>Array<br>Structures | With appropriate control circuitry, a microfluidic structure having a light-reflecting membrane may be employed as a digital or analog mirror array.               | PCT/US00/<br>17740                               | 38                  |
| Refractive<br>Devices         | Refractive device having elastomeric material capable of transmitting incident light   | PCT/US00/<br>17740                               | 39<br>40<br>41      |

## APPENDIX B

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## General Icon Properties

Two distinguishable colors representing channels on different layers. Red in this case representing the control channel and blue the fluidic channel. There are typically two ports on each of the channels represented by white circles, or dots, sometimes outlined with black circles. Some of the icons will only have one color representing a channel only present on one layer and others will have two colors representing components composed of multiple channels on multiple layers.

### Orientation

The orientation of the components in the icons does not represent its final placement in the microfluidic design. Once the component is placed, it can be rotated with freedom to any degree (0 – 360).

## Valve



Valve

### Description:

The valve icon represents the basic switching element and consists of channels of different widths and lengths with connection points, or ports.

## T- Switch



T-Switch

### Description:

The T-Switch represents a basic component that is used to direct the incoming flow in the fluidic channel to none or one of two channels based on the state of the control channels. The channels for both the fluidic and control layer can be of different widths and lengths with connection points, or ports.

## Control Tapers



Control Taper

### Description:

The Control Taper is a basic component that allows a connection from a larger control channel to a smaller control channel or visa versa. The ends of the tapers can be of different widths based on the needed geometries of what needs to be connected.

## Fluid Taper



Fluid Taper

### Description:

The Fluid Taper is a basic component that allows a connection from a larger fluid channel to a smaller fluid channel or visa versa. The ends of the tapers can be of different widths based on the needed geometries of what needs to be connected.

## Peristaltic Pump



Pump

### Description:

The Peristaltic Pump is a basic component that allows the active control of fluid in either direction. The actual channels, both fluidic and control, can be of different widths based on the geometries required for proper operation.

## Pump and Dampener



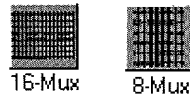
Pump+Dampener

### Description:

The Peristaltic Pump and Dampener is a basic component that allows the active control of fluid in either direction and includes dampening channels to smoothen the flow of fluid.

The actual channels, both fluidic and control, can be of different widths based on the geometries required for proper operation.

## Multiplexers



### Description:

The Multiplexers are basic component that allows the active control of fluid in 8 or 16 fluid channels based on a binary application of control signals to the control channels. The actual channels, both fluidic and control, can be of different widths based on the geometries required for proper operation. In general, these icons can be extended to cover N fluid lines controlled by  $2\log N$  control lines.

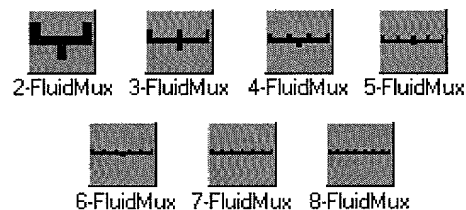
## Rotary Mixers



### Description:

The Rotary Mixers are basic components and come in different configurations based on the application needs. The Rotary Mixer comes in three basic variations of the fluid input and output ports: 2 fluid input/output (I/O), 3 fluid I/O, and 4 fluid I/O. The Rotary Mixer Sq has a different topology which allows “tiling” of the mixers and comes in two basic variations of the fluid input and output ports: 2 fluid input/output (I/O) and 3 fluid I/O. The actual channels, both fluidic and control, can be of different widths based on the geometries required for proper operation.

## Fluid Mux Connectors



The Fluid Mux Connectors are basic components that are sized and positioned to work the Multiplexer and Channel Array Components. These icons represent the “mux” connections from 2 through 8 array or multiplexer outputs or inputs.

## Bridges

The purpose of the Bridge component is to allow control lines to cross over fluid lines without stopping the flow of the fluid line below it. This feature enables the user to design the chip with more complexity and greater density. Note: The flow line is not completely unaffected because the membrane of the bridge component will deflect when the control line is actuated. The amount of deflection will depend upon the amount of pressure that is applied to the control line.

## Channel Arrays

The channel array provides a set of individually addressable flow lines. The number of control lines is equal to the number of flow lines for this component. The flow of the liquid within the array can be controlled in any fashion by actuating the necessary control lines.

## Control Components

The Control components allow the Control lines to be arranged in the configurations required by the user. The dimensions of these components have been established using the minimum recommended lengths for the individual components.

## Dampeners

The Dampener elements are used provide smoother flow of pumped liquid. The membrane of the Dampener element will deflect and absorb the energy caused by the closing of the valves of the peristaltic pump.

## Fluid Components

The Fluid components allow the Fluid lines to be arranged in the configurations required by the user. The dimensions of these components have been established using the minimum recommended lengths for the individual components.

## Fluid Mux Connectors

The Fluid Mux Connectors enable the user to interface the flow lines of the Multiplexer and Channel arrays to other components. They have been designed to match the flow line spacing for these components.

## Mixers

The Mixers are used to mix two or more different liquids within a closed loop. Mixing is accomplished by pumping the liquid around the closed loop. Parabolic flow of the liquid within the loop allows for fast and efficient mixing. The different Mixer orientations allow the user to arrange the mixers in various configurations (arrays, etc.) depending upon requirements.

## Tapers

The taper element is required when varying the width of the control lines or the fluid lines. This requirement is necessary because of the manufacturing process involved in making the molds for the chips.

## Multiplexers

The Multiplexer element allows the user to flow liquid in any single flow line at a given time using a predetermined control scheme. The number of control lines required for a given multiplexer can be calculated using the equation  $2(\log_2 N)$ , where

N is the number of flow lines. The advantage of the Multiplexer becomes more obvious as larger arrays are used, where the number of control lines can be significantly less than the number of flow lines.

#### Pumps

The Pump element is a peristaltic pump which is composed of three individual valves. The liquid within the flow lines are pumped by sequentially actuating the individual valves. The Pump can be used with or without the Dampener element.

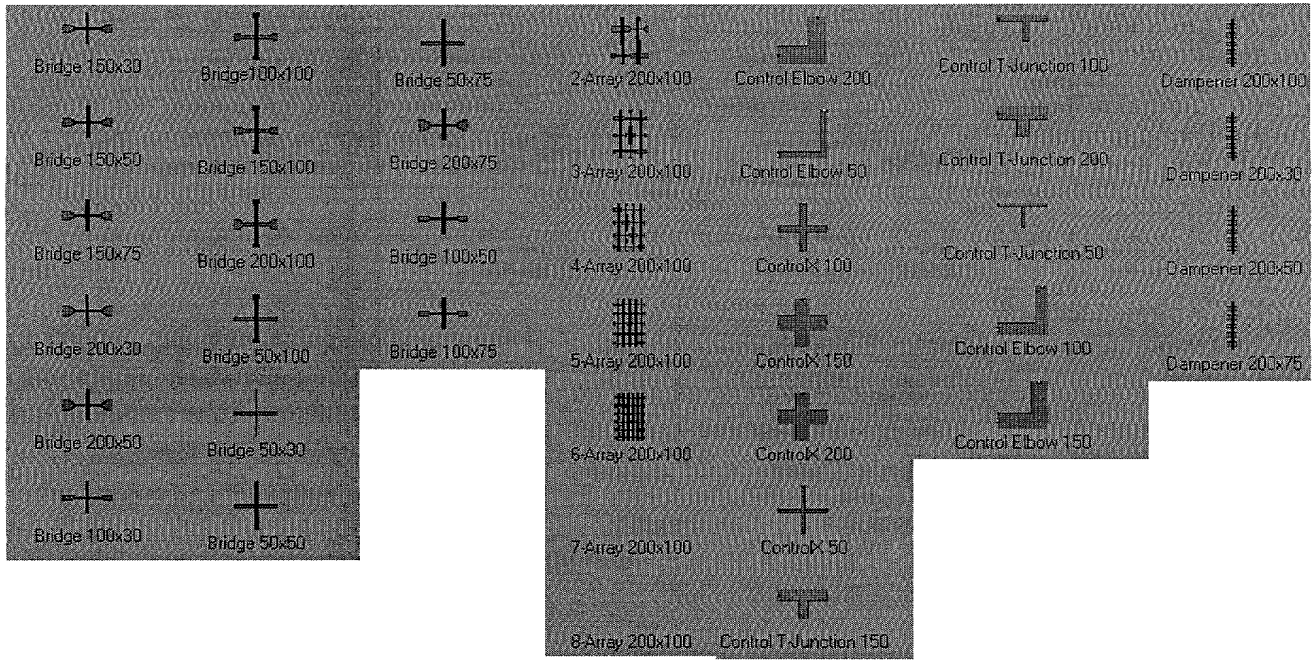
#### T-Switch




































The T-Switch element allows the user to control the input of two flow lines into a single flow line or vice versa. The valve elements can be used to turn the flow of each input on and off so that the desired liquid runs through the single line or the valves can be used to separate the flow from a single line to two lines.

#### Valve

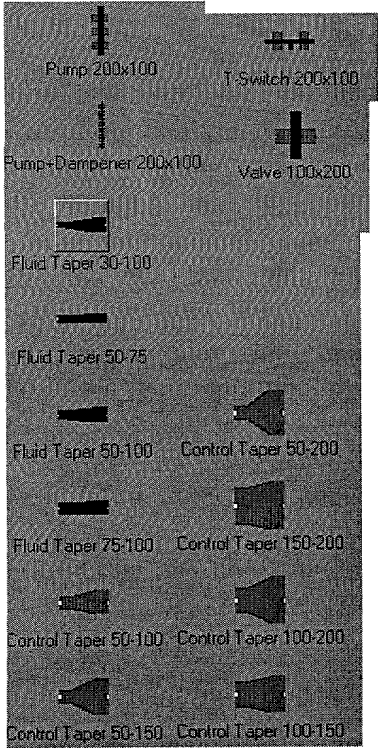
The valve element is used to turn the liquid flow on and off. This is controlled by providing sufficient air pressure to cause the membrane to deflect and pinch off the flow line.

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|   |   |   |   |   |   |
|---|---|---|---|---|---|
|  |  |  |  |  |  |
| FluidX 30   | Fluid Elbow 100   | 2-FluidMux100   | 3000-Rotary Mixer Sq 200x100-3  | 1000-Rotary Mixer 200x100   | 16-Mux 200x100  |
|  |  |  |  |  |  |
| FluidX 50   | Fluid Elbow 30  | 3-FluidMux100   | 4000-Rotary Mixer 200x100   | 1000-Rotary Mixer 200x100-4   | 8-Mux 200x100   |
|  |  |  |  |  |   |
| FluidX 75   | Fluid Elbow 50  | 4-FluidMux100   | 4000-Rotary Mixer 200x100-4   | 2000-Rotary Mixer 200x100   |   |
|  |  |  |  |  |   |
| Fluid T-Junction 75   | Fluid Elbow 75  | 5-FluidMux100   | 4000-Rotary Mixer Sq 200x100-3  | 2000-Rotary Mixer 200x100-4   |   |
|  |  |  |  |  |   |
| Fluid T-Junction 30   | FluidX 100  | 6-FluidMux100   | 2000-Rotary Mixer Sq 200x100-2  | 2000-Rotary Mixer Sq 200x100-3  |   |
|  |   |  |  |  |   |
| Fluid T-Junction 50   |   | 7-FluidMux100   | 3000-Rotary Mixer Sq 200x100-2  | 3000-Rotary Mixer 200x100   |   |
|  |   |  |  |  |   |
| Fluid T-Junction 100  |   | 8-FluidMux100   | 4000-Rotary Mixer Sq 200x100-2  | 3000-Rotary Mixer 200x100-4   |   |





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# Appendix C

## FluidArchitect™ User's Guide/Reference Manual

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| 1. Personal Information |                                       | 2. Employment Information |                       | 3. Financial Information |           | 4. Social Security Information |            | 5. Other Information |       |
|-------------------------|---------------------------------------|---------------------------|-----------------------|--------------------------|-----------|--------------------------------|------------|----------------------|-------|
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| John Doe                | 123 Main St, New York, NY 10001       | ABC Corp                  | Software Engineer     | \$80,000                 | \$100,000 | 123-456789                     | 01/01/1980 | Married              | None  |
| Jane Smith              | 456 Elm St, Los Angeles, CA 90001     | XYZ Inc                   | Marketing Manager     | \$60,000                 | \$50,000  | 987-654321                     | 05/15/1975 | Single               | None  |
| Robert Johnson          | 789 Oak St, Chicago, IL 60601         | DEF LLC                   | Operations Director   | \$120,000                | \$200,000 | 555-111222                     | 03/22/1965 | Divorced             | None  |
| Sarah Williams          | 101 Pine St, San Francisco, CA 94101  | GHI Corp                  | Product Designer      | \$70,000                 | \$75,000  | 333-444555                     | 08/10/1985 | Single               | None  |
| Michael Brown           | 202 Cedar St, Houston, TX 77001       | JKL Inc                   | Finance Analyst       | \$50,000                 | \$30,000  | 666-777888                     | 11/05/1990 | Single               | None  |
| Emily Davis             | 303 Birch St, Phoenix, AZ 85001       | MNO Corp                  | Human Resources       | \$40,000                 | \$20,000  | 999-000111                     | 06/18/1982 | Single               | None  |
| David Miller            | 404 Spruce St, Portland, OR 97201     | PQR LLC                   | Systems Administrator | \$65,000                 | \$45,000  | 222-333444                     | 09/03/1978 | Married              | None  |
| Olivia Wilson           | 505 Ash St, San Diego, CA 92101       | STU Inc                   | Business Development  | \$90,000                 | \$120,000 | 555-666777                     | 02/28/1970 | Single               | None  |
| James Taylor            | 606 Hickory St, Dallas, TX 75201      | VWX Corp                  | Quality Assurance     | \$55,000                 | \$35,000  | 888-999000                     | 07/12/1988 | Single               | None  |
| Isabella Anderson       | 707 Walnut St, San Jose, CA 95101     | YZA LLC                   | UX Researcher         | \$75,000                 | \$90,000  | 111-222333                     | 04/08/1983 | Single               | None  |
| Benjamin Thomas         | 808 Maple St, Austin, TX 78701        | BCD Inc                   | Project Manager       | \$85,000                 | \$110,000 | 444-555666                     | 10/25/1972 | Married              | None  |
| Mia Garcia              | 909 Cedar St, San Antonio, TX 78201   | EFG Corp                  | Operations Manager    | \$60,000                 | \$40,000  | 777-888999                     | 03/14/1979 | Single               | None  |
| Lucas Martinez          | 1010 Oak St, Fort Worth, TX 76101     | HIJ LLC                   | Software Tester       | \$45,000                 | \$25,000  | 000-111222                     | 12/01/1992 | Single               | None  |
| Charlotte Lopez         | 1111 Pine St, El Paso, TX 79901       | KLM Inc                   | Marketing Coordinator | \$35,000                 | \$15,000  | 333-444555                     | 09/16/1987 | Single               | None  |
| Leo Hernandez           | 1212 Elm St, Albuquerque, NM 87101    | NOP Corp                  | Systems Engineer      | \$70,000                 | \$85,000  | 666-777888                     | 01/20/1981 | Single               | None  |
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| Sebastian Wright        | 1414 Pine St, Las Vegas, NV 89101     | TUV Inc                   | Operations Director   | \$110,000                | \$150,000 | 222-333444                     | 08/24/1968 | Married              | None  |
| Valentina Scott         | 1515 Elm St, Reno, NV 89501           | WXY Corp                  | Business Analyst      | \$65,000                 | \$55,000  | 555-666777                     | 02/11/1984 | Single               | None  |
| Julian Green            | 1616 Oak St, Sacramento, CA 95811     | ZAB LLC                   | Software Engineer     | \$80,000                 | \$100,000 | 888-999000                     | 06/03/1977 | Single               | None  |
| Skylar Adams            | 1717 Pine St, San Francisco, CA 94102 | ACD Inc                   | Marketing Manager     | \$70,000                 | \$90,000  | 111-222333                     | 04/19/1980 | Single               | None  |
| Grayson Baker           | 1818 Elm St, San Jose, CA 95102       | BEF Corp                  | Operations Director   | \$100,000                | \$140,000 | 444-555666                     | 07/06/1971 | Married              | None  |
| Isabella Clark          | 1919 Oak St, San Diego, CA 92102      | GHI LLC                   | Product Designer      | \$75,000                 | \$110,000 | 777-888999                     | 01/13/1986 | Single               | None  |
| Julian Evans            | 2020 Pine St, San Antonio, TX 78202   | JKL Inc                   | Finance Analyst       | \$50,000                 | \$30,000  | 000-111222                     | 10/02/1991 | Single               | None  |
| Skylar Foster           | 2121 Elm St, Fort Worth, TX 76102     | MNO Corp                  | Human Resources       | \$40,000                 | \$20,000  | 333-444555                     | 08/17/1989 | Single               | None  |
| Grayson Grant           | 2222 Oak St, El Paso, TX 79902        | PQR LLC                   | Systems Administrator | \$65,000                 | \$45,000  | 666-777888                     | 03/26/1976 | Married              | None  |
| Isabella Harris         | 2323 Pine St, Albuquerque, NM 87102   | STU Inc                   | Business Development  | \$90,000                 | \$120,000 | 999-000111                     | 06/09/1974 | Single               | None  |
| Julian King             | 2424 Elm St, Santa Fe, NM 87502       | VWX Corp                  | Quality Assurance     | \$55,000                 | \$35,000  | 222-333444                     | 09/18/1983 | Single               | None  |
| Skylar Lee              | 2525 Oak St, Las Vegas, NV 89102      | YZA LLC                   | UX Researcher         | \$75,000                 | \$90,000  | 555-666777                     | 02/29/1981 | Single               | None  |
| Grayson Miller          | 2626 Pine St, Reno, NV 89502          | BCD Inc                   | Project Manager       | \$85,000                 | \$110,000 | 888-999000                     | 07/14/1972 | Married              | None  |
| Isabella Nelson         | 2727 Elm St, Sacramento, CA 95812     | EFG Corp                  | Operations Manager    | \$60,000                 | \$40,000  | 111-222333                     | 04/21/1978 | Single               | None  |
| Julian Ortiz            | 2828 Oak St, San Francisco, CA 94103  | HIJ LLC                   | Software Tester       | \$45,000                 | \$25,000  | 444-555666                     | 12/04/1993 | Single               | None  |
| Skylar Parker           | 2929 Pine St, San Antonio, TX 78203   | KLM Inc                   |                       |                          |           |                                |            |                      |       |

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|  |           |
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## What is a Microfluidic Chip?

## What is FluidArchitect?

FluidArchitect is the design automation applications portion of a revolutionary microfluidics platform that Fluidigm has built and continues to develop. This platform allows the user the ability to design customized microfluidic chips from Fluidigm's library of basic building blocks components with built in rule checking and submit the design for fabrication.

The design automation tool guides the user through the design process setup process and allows the user the ability to simply drag, drop, click, and connect components to form a customized microfluidic chip. User's who are familiar with Microsoft Windows applications will be able to use the FluidArchitect.

## FluidArchitect User Requirements

Users of the FluidArchitect design automation application should have the following requirements:

- A good understanding and previous experience with microfluidics
- Experience with computer aided design applications

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The following are the system requirements for installing FluidArchitect onto a PC.

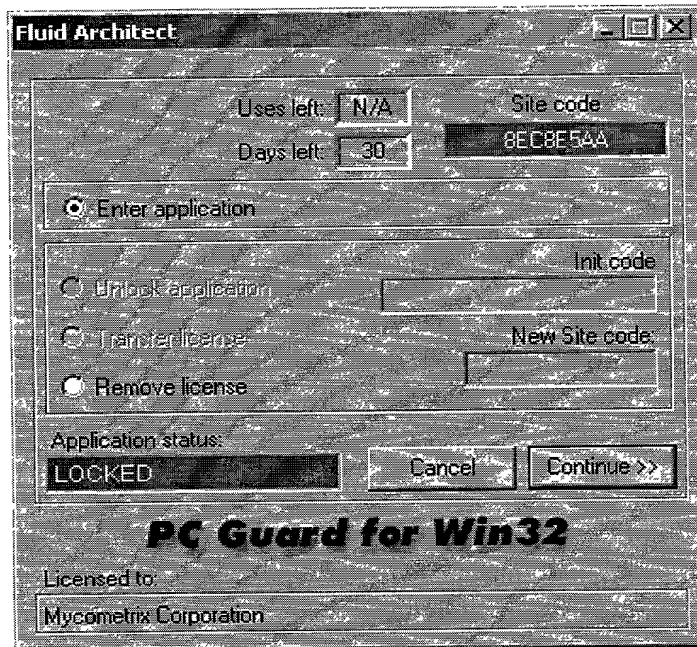
- ## Installing FluidArchitect

## Requesting a License

Once you have successfully installed the program onto your computer you will need to request a license to unlock the FluidArchitect application in order to use it. The unlock code that will be generated is specifically for the computer the application is installed on. Follow the steps outlined below to request a license for your copy of FluidArchitect.

1. Start the FluidArchitect installer.
2. The InstallShield application will now walk you through the steps of selecting a target directory and installing all the necessary files and directories onto your computer.
3. After finishing installation, go to *Programs > Fluid Architect > Fluid Architect* under the *Start* menu on your computers desktop to start the FluidArchitect application.

- | Variable              | Mean | SD   | Min  | Max  |
|-----------------------|------|------|------|------|
| Age                   | 38.5 | 12.5 | 25   | 65   |
| Gender                | 0.5  | 0.5  | 0    | 1    |
| Marital Status        | 0.5  | 0.5  | 0    | 1    |
| Education             | 12.5 | 2.5  | 9    | 16   |
| Income                | 3500 | 1500 | 1000 | 8000 |
| Health Status         | 0.5  | 0.5  | 0    | 1    |
| Exercise Frequency    | 2.5  | 1.5  | 0    | 5    |
| Stress Level          | 4.5  | 1.5  | 1    | 7    |
| Sleep Quality         | 3.5  | 1.5  | 1    | 6    |
| Dietary Habits        | 0.5  | 0.5  | 0    | 1    |
| Work-Life Balance     | 3.5  | 1.5  | 1    | 6    |
| Family Support        | 4.5  | 1.5  | 1    | 7    |
| Community Involvement | 2.5  | 1.5  | 0    | 5    |
| Overall Well-being    | 4.5  | 1.5  | 1    | 7    |



**Figure 1 – License Manager**

5. Select the Site code and copy the code. Paste the code into an email along with the following information:
  - Contact Name
  - Company
  - Address
  - Phone Number
  - Fax Number (optional)
  - Email Address
6. Email the information to [license@fluidigm.com](mailto:license@fluidigm.com). A license will be generated and emailed back to you typically within 24 hours.

## Licensing FluidArchitect

After you have received an email containing your Initialization code, follow the steps below to license FluidArchitect.

1. You will receive a 16 digit alphanumeric string based on the Site code sent in your email.
2. Enter the 16 digit alphanumeric string EXACTLY as it is shown in the email including the “-” character which separates the strings. See Figure 2. In this case the Init code of TEST-123455678-LOCK was entered.
3. Click the *Continue* >> button to complete the licensing process.





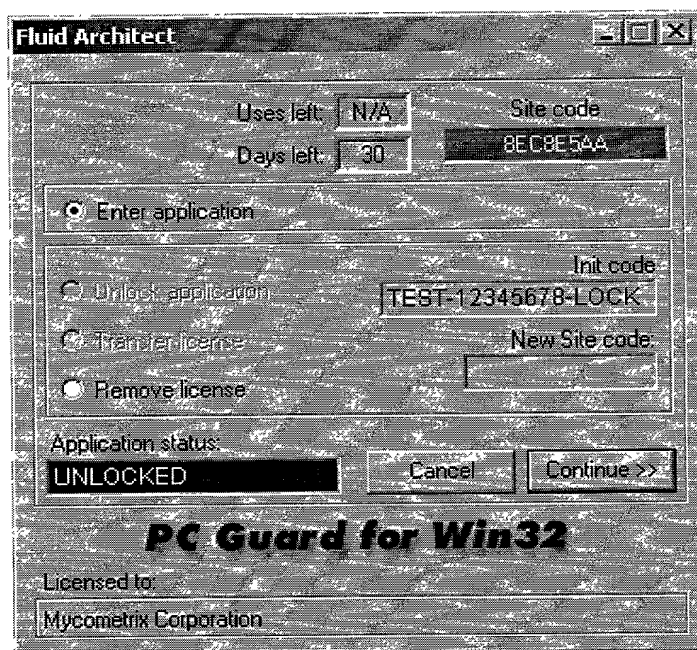


Figure 2 – Dialog to Enter the Init Code

4. After successful entry of the Init code the application is ready for use.

## Trouble Shooting Licensing

Check the following items to resolve licensing issues:

- Check the Site code sent to Fluidigm for Init code generation. If the Site code does not match what is displayed in the dialog box then the Init code will not work. Resend the correct Site code for a new Init code following the directions given in the previous sections.
- FluidArchitect has been successfully installed and removed from the computer you are trying to reinstall onto. Once the application has been removed from a computer it is not possible to reinstall and use the old license. A new license must be generated but the existing license from your current working installation must be removed first and verified before a new Init code can be sent.

## Chapter 2 – Design Process

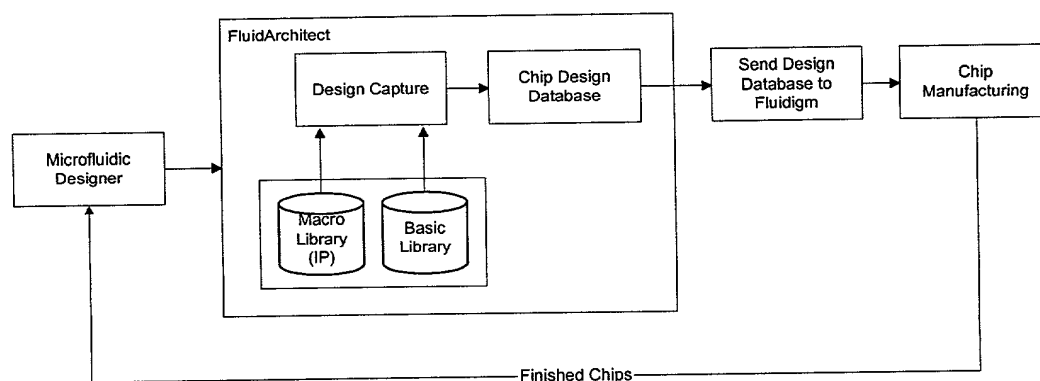


Figure 3 – Microfluidic Chip Design Process with FluidArchitect

### Design Flow Process

The design process for designing and building a microfluidic chip is described in Figure 1. Application specific microfluidic chips can be created using the library components provided by Fluidigm. FluidArchitect allows you to capture your design in a simple drag and drop, point and click design environment. Once the design has been completed it is sent to Fluidigm for fabrication. Fabricated devices are sent back to the microfluidic designer for use.

### Application Interface

FluidArchitect's interface contains the entire environment in which a design will be started and completed for submission to Fluidigm for fabrication.

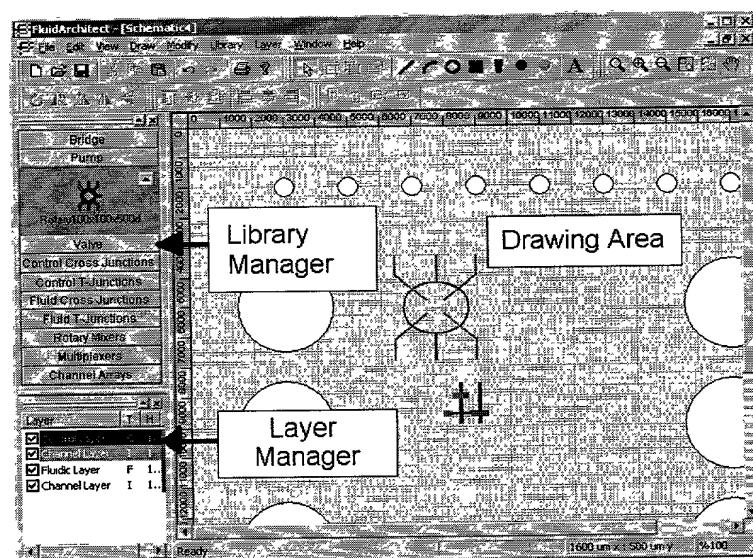


Figure 4 – FluidArchitect's User Interface

The user interface has three primary components: *Library Manager*, *Layer Manager*, and *Drawing Area* (see Figure 4).

#### *Library Manager*

The component libraries come predefined and are installed with the FluidArchitect application. The library components are tested and approved for use in the microfluidic chip making process. These libraries will be updated with new components as they are approved from Fluidigm for use. The component library will be delivered as part of a new release or

|   | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|-----|
| 1 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 3 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 4 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| 5 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |     |

## Submitting a Design Database for Fabrication

Once the design has been completed and verified free of errors it can be submitted to Fluidigm for fabrication. The design database can be found in the directory that the design was created in. The file extension of the design database is \*.mdx. This file can be sent to [manufacturing@fluidigm.com](mailto:manufacturing@fluidigm.com) along with your contact information. A representative from Fluidigm will contact you regarding the details of your order for fabrication.

[illegible]

# Chapter 3 – Design Editor Reference

## Introduction

The goal of the design editor is to help you design effectively and as efficiently as possible. The libraries that are built into FluidArchitect represent microfluidic structures that are approved for implementation in Fluidigm's processes. "Channel" drawing tools are provided to connect the microfluidic structures available from the libraries. The sections below will describe the design editor in detail.

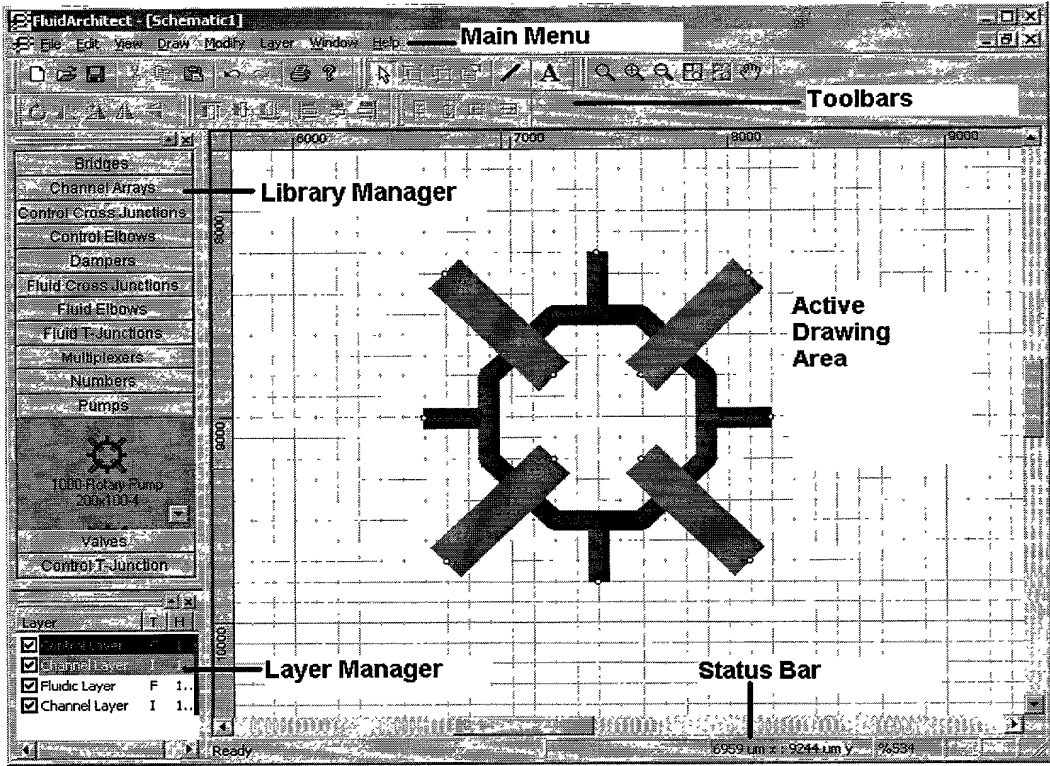


Figure 5 – FluidArchitect Main User Interface (Main Menu, Toolbars, Library Manager, Layer Manager, and Active Drawing Area)

## Menus

### Main Menu

The main menu is composed of nine menu groups which group related operations and commands for the application.



Figure 6 – Main Menu Bar

| Variable                                  | Control group |         | Intervention group |         |
|---|---------------|---------|--------------------|---------|
|   | Mean (SD)     | Range   | Mean (SD)          | Range   |
| Age (years)                               | 50.5 (10.5)   | 35-65   | 50.5 (10.5)        | 35-65   |
| Gender (male/female)                      | 25/25         |         | 25/25              |         |
| Education (years)                         | 12.5 (2.5)    | 8-16    | 12.5 (2.5)         | 8-16    |
| Occupation (white/blue)                   | 15/10         |         | 15/10              |         |
| Marital status (married/divorced/widowed) | 20/5/0        |         | 20/5/0             |         |
| Family size (children)                    | 2.5 (1.5)     | 0-4     | 2.5 (1.5)          | 0-4     |
| Income (€1000/month)                      | 1.5 (0.5)     | 0.5-2.5 | 1.5 (0.5)          | 0.5-2.5 |
| Health status (good/fair/poor)            | 15/10/0       |         | 15/10/0            |         |
| Smoking status (smoker/non-smoker)        | 10/15         |         | 10/15              |         |
| Alcohol consumption (g/day)               | 20 (10)       | 0-40    | 20 (10)            | 0-40    |
| Physical activity (hours/week)            | 2.5 (1.5)     | 0-5     | 2.5 (1.5)          | 0-5     |
| Stress level (low/moderate/high)          | 10/10/5       |         | 10/10/5            |         |
| Depression score (0-10)                   | 2.5 (1.5)     | 0-5     | 2.5 (1.5)          | 0-5     |
| Life satisfaction score (0-10)            | 7.5 (1.5)     | 5-10    | 7.5 (1.5)          | 5-10    |
| Quality of life score (0-10)              | 6.5 (1.5)     | 4-10    | 6.5 (1.5)          | 4-10    |
| Healthcare utilization (visits/year)      | 3.5 (1.5)     | 0-6     | 3.5 (1.5)          | 0-6     |
| Health insurance status (public/private)  | 20/5          |         | 20/5               |         |
| Healthcare access (easy/difficult)        | 15/10         |         | 15/10              |         |
| Healthcare cost (€1000/year)              | 1.5 (0.5)     | 0.5-2.5 | 1.5 (0.5)          | 0.5-2.5 |
| Healthcare satisfaction (0-10)            | 7.5 (1.5)     | 5-10    | 7.5 (1.5)          | 5-10    |
| Healthcare quality (0-10)                 | 6.5 (1.5)     | 4-10    | 6.5 (1.5)          | 4-10    |
| Healthcare accessibility (0-10)           | 5.5 (1.5)     | 3-10    | 5.5 (1.5)          | 3-10    |
| Healthcare affordability (0-10)           | 4.5 (1.5)     | 2-10    | 4.5 (1.5)          | 2-10    |
| Healthcare availability (0-10)            | 3.5 (1.5)     | 1-10    | 3.5 (1.5)          | 1-10    |
| Healthcare acceptability (0-10)           | 2.5 (1.5)     | 0-10    | 2.5 (1.5)          | 0-10    |
| Healthcare appropriateness (0-10)         | 1.5 (1.5)     | 0-10    | 1.5 (1.5)          | 0-10    |
| Healthcare effectiveness (0-10)           | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare safety (0-10)                  | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare equity (0-10)                  | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare transparency (0-10)            | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare accountability (0-10)          | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare responsiveness (0-10)          | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare reliability (0-10)             | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare predictability (0-10)          | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare consistency (0-10)             | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare coherence (0-10)               | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare integrity (0-10)               | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare honesty (0-10)                 | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare openness (0-10)                | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare communication (0-10)           | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare information (0-10)             | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare education (0-10)               | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare training (0-10)                | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare research (0-10)                | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare innovation (0-10)              | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare leadership (0-10)              | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare vision (0-10)                  | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare mission (0-10)                 | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare values (0-10)                  | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare culture (0-10)                 | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare environment (0-10)             | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare facilities (0-10)              | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare equipment (0-10)               | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare staff (0-10)                   | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare services (0-10)                | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare programs (0-10)                | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare policies (0-10)                | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare procedures (0-10)              | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare protocols (0-10)               | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare standards (0-10)               | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare guidelines (0-10)              | 0.5 (1.5)     | 0-10    | 0.5 (1.5)          | 0-10    |
| Healthcare best practices (0-10)          | 0.5 (1.       |         |                    |         |



**File > New**

## File > Open...

**File > Close**

## File > Save

**File > Save As...**

*File > Page Setup*

*File > Print*

*File > Print Preview*

13

## Edit Menu

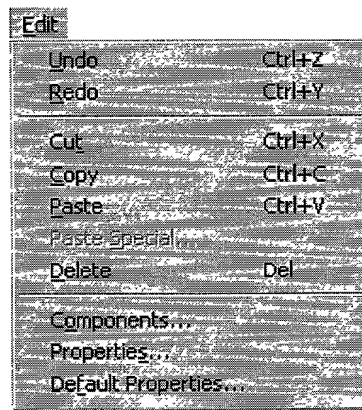


Figure 8 – Edit Menu Commands

### Edit > Undo

The *Undo* command will undo the last command you executed on the active design project.

### Edit > Redo

The *Redo* command will reverse the last command *Undo* command you executed on the active design project.

### Edit > Cut

The *Cut* command cuts and pastes all selected components in the drawing area into the Clipboard.

### Edit > Copy

The *Copy* command copies and pastes all selected components in the drawing area into the Clipboard.

### Edit > Paste

The *Paste* command will paste the contents of the Clipboard into the drawing area. Only objects using the *Cut* or *Copy* command can be pasted from the Clipboard.

### Edit > Paste Special

Not Currently Defined.

### Edit > Delete

The *Delete* command is used to delete any selected object in the active drawing area.

### Edit > Components

The *Components* command will bring up the Components dialog box. The dialog box, Figure 5, will show all of the components that are currently placed into the active drawing area.

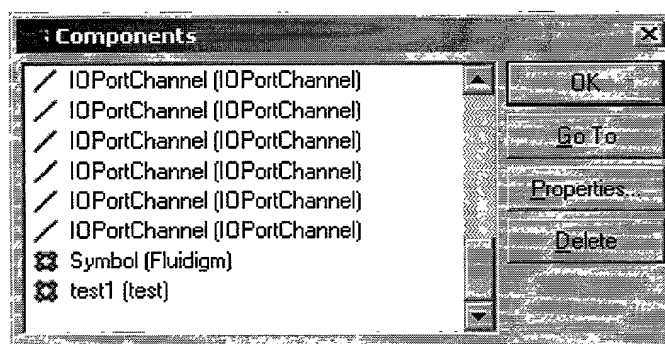


Figure 9 – Component Dialog Box

Additional commands available from this dialog box are:

- **OK** – Closes the dialog box
- **Go To** – Not currently implemented
- **Properties** – Opens the Properties dialog sheet for the component
- **Delete** – Not currently implemented

### **Edit > Default Properties**

The *Default Properties* command will bring up the Properties dialog box for the entire design. The dialog box, Figure 6, will show all of the default settings for the design

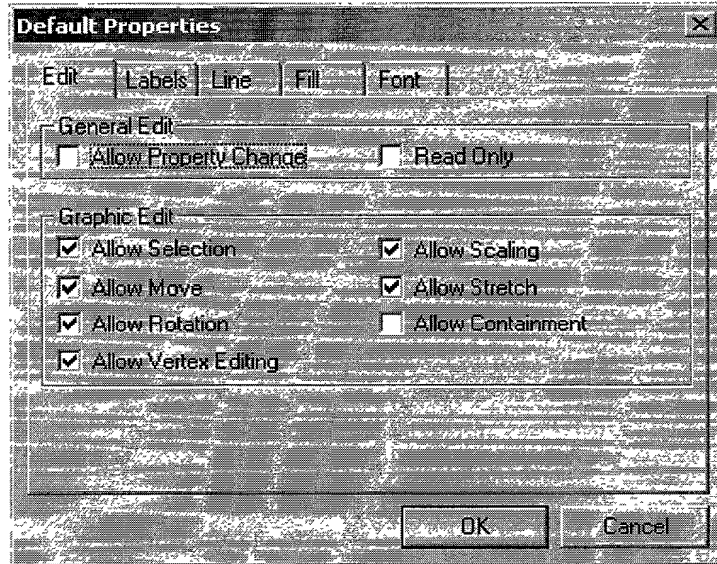


Figure 10 – Default Properties Dialog Box

- **OK** – Closes the dialog box and save any changes
- **Cancel** – Closes the dialog box and discards changes
- **Edit tab** – Not currently implemented
- **Labels** – Sets the label orientation for components
- **Line** – Not currently implemented
- **Fill** – Not currently implemented
- **Font** – Sets the fonts options for the labels



# View Menu

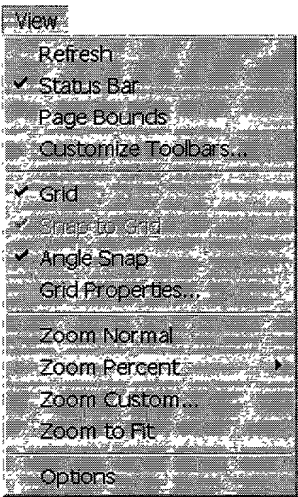


Figure 11 – View Menu Commands

## View > Refresh

The *Refresh* command will redraw the active drawing area. Sometimes the drawing area may not refresh completely during editing of the design leaving screen artifacts. The *Refresh* command can be used to redraw the screen to eliminate the artifacts. Note that the artifacts will not be saved into the design.

## View > Status Bar

The *Status Bar* command can be used to display or remove the status bar in the lower right corner of the application. The Status Bar, Figure 12, shows the selected component, the screen location of the cursor, and the percent zoomed.



Figure 12 – Status Bar

## View > Page Bounds

The *Page Bounds* not currently implemented.

## View > Customize Toolbars...

The *Customize Toolbars...* allow you to show or hide the toolbar tool bars in the application window directly under the Main Menu bar. Figure 13 shows the dialog box that appears when this command is selected. All of the toolbars, including the Main Menu bar, can be displayed or hidden based on settings made through this dialog box with the Toolbars tab selected.



The toolbars can be customized by dragging and dropping commands icons from the dialog box directly into the existing toolbars present in the application. Figure 14 shows the “Buttons” or commands that can be left click and dragged to the toolbars.

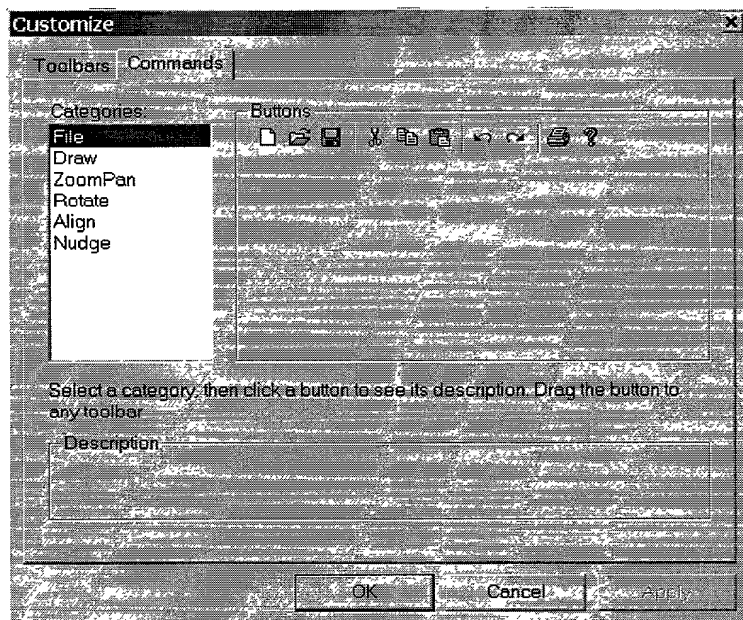


Figure 14 – Customized Toolbars Dialog Box with Commands tab selected

The *Grid* command enables or disables the grid to be displayed in the active drawing area.

### View > Grid Properties...

The *Grid Properties...* command will bring up the dialog box, Figure 15. The Grid dialog box allows you to set the grid color and the intervals at which the grid is rendered and also to enable or disable the grid from the drawing area.

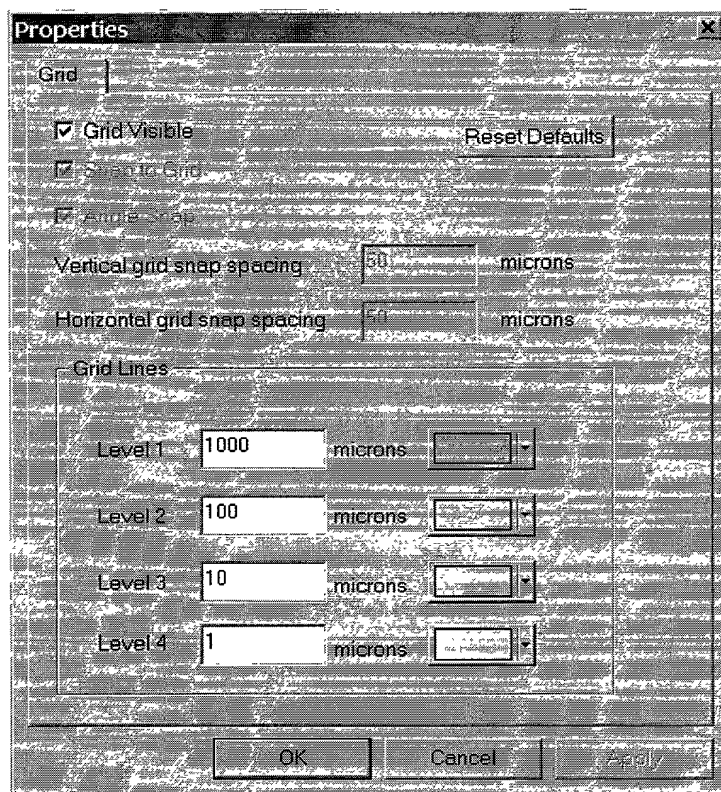


Figure 15 – Grid Properties Dialog Box

### View > Zoom Normal

The *Zoom Normal* command will zoom the view of the active drawing area to view the entire chip.

### View > Zoom Percent

The *Zoom Percent* command allows you to select 50%, 75%, 100%, and 200% zoom of the active drawing area.

### View > Zoom Custom...

The *Zoom Custom...* command allows you to select 50%, 75%, 100%, and 200% from the drop down box and you can also enter in your own zoom factor of the active drawing area.

### View > Zoom Fit

The *Zoom Fit* command will zoom the view of the active drawing area to view the entire chip.

### View > Options

The *Options* command will bring up the *Grid* and *Library* dialog box, Figure 16. The Grid properties are the same as those in the *View > Grid Properties...*

10/29/2016 2:29:29 PM

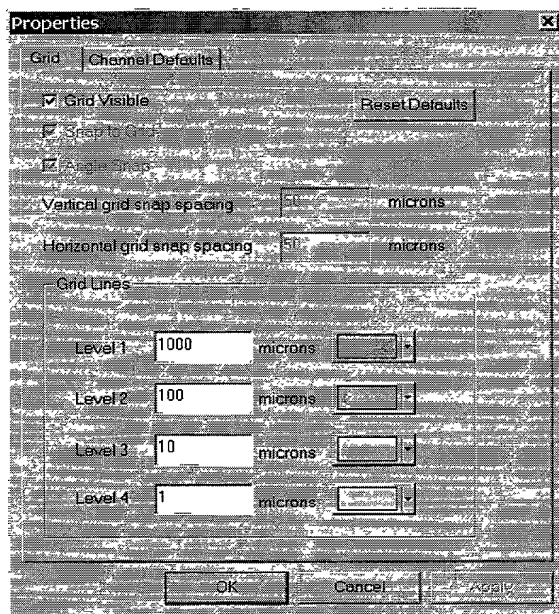


Figure 16 – Grid and Channel Defaults Dialog Box

The Channel Defaults allow you to set the default channel widths for the fluidic and the control layer channels that are draw to interconnect the library components. Figure 17 shows the dialog box with the Channel Defaults tab selected.

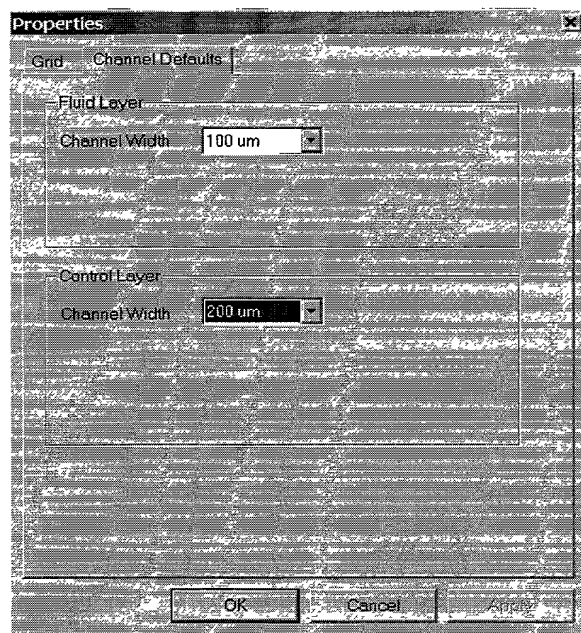


Figure 17 – Channel Defaults Selection Dialog Box

The drop down boxes allows you to set the default width of the channel that you draw on both the fluidic and control layer. Keep in mind that any drawn channel's width can be changed using the Property sheet for each channel.



[illegible]

Figure 18 – Draw Dialog Box

## Draw > Channel

The *Channel* command places the mode of the active drawing area into drawing channels. A drawn channel will be to the layer that is currently “Active”. A layer can be set active in two methods: enabling the layer to be active through the *Library Manager*, Figure 12, or through a right mouse click while in the active drawing area with the *Select* tool selected. Select the *Layers* command to set the desired layer, Figure 19.

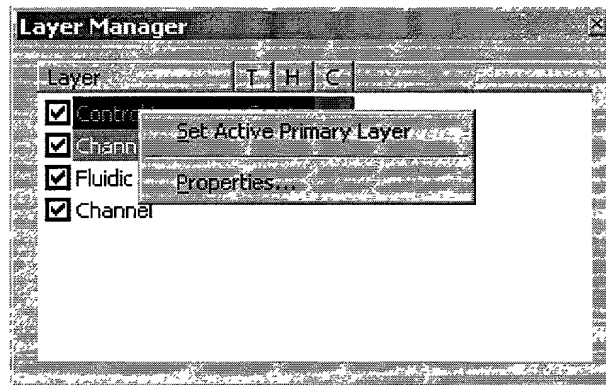


Figure 19 – Library Manager Window

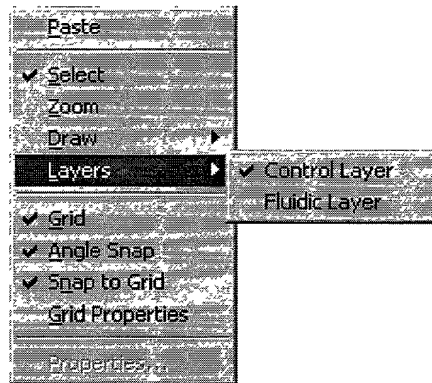
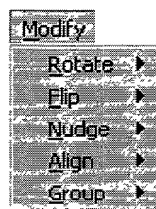


Figure 20 – Right Click Pop Up Menu in Drawing Area

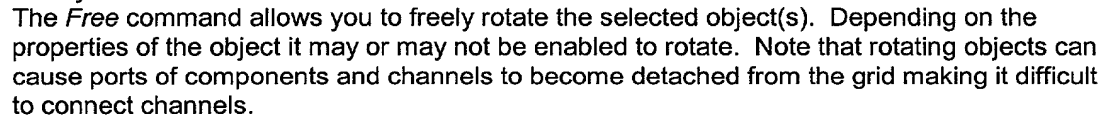
## Modify Menu



### Figure 21 – Modify Menu Commands

| Table 1. Demographic characteristics of the study population |             |
|--|-------------|
| Age (years)  | 50.0 ± 10.0 |
| Gender   |             |
| Male   | 50.0%       |
| Female   | 50.0%       |
| Marital status   |             |
| Married  | 80.0%       |
| Single   | 20.0%       |
| Education level  |             |
| High school  | 30.0%       |
| College  | 40.0%       |
| University   | 30.0%       |
| Postgraduate   | 10.0%       |
| Occupation   |             |
| Professional   | 40.0%       |
| Managerial   | 30.0%       |
| Technical  | 20.0%       |
| Service  | 10.0%       |
| Unemployed   | 10.0%       |
| Income (USD/month)   |             |
| < 1000   | 20.0%       |
| 1000-2000  | 30.0%       |
| 2000-3000  | 30.0%       |
| > 3000   | 20.0%       |


*Modify > Rotate > Free*



*Modify > Rotate > Right*

*Modify > Rotate > Left*

## Modify > Flip



*Modify > Flip > Horizontal*

*Modify > Flip > Vertical*

## Modify > Nudge

The screenshot shows a 'Modify' menu with the following options: Rotate, Flip, Nudge (highlighted), Align, and Group. A sub-menu for 'Nudge' is open, displaying 'Down', 'Up', 'Left', and 'Right'.

**■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■ ■**

10/29/2006 2:34:36 PM

**Modify > Nudge > Down**

The *Down* command allows you to move the selected object(s) down one micron in the active drawing area. Holding the Shift key while executing this command will move the object 5 microns.

**Modify > Nudge > Up**

The *Up* command allows you to move the selected object(s) up one micron in the active drawing area. Holding the Shift key while executing this command will move the object 5 microns.

**Modify > Nudge > Left**

The *Left* command allows you to move the selected object(s) left one micron in the active drawing area. Holding the Shift key while executing this command will move the object 5 microns.

**Modify > Nudge > Right**

The *Right* command allows you to move the selected object(s) right one micron in the active drawing area. Holding the Shift key while executing this command will move the object 5 microns.

**Modify > Align**

The *Align* command contains a submenu of commands, Figure 25, which can be performed on a selected object(s) in the active drawing area.

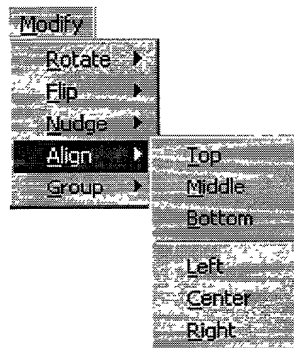


Figure 25 – Align Submenu Commands

**Modify > Align > Top**

The *Top* command allows you to select a group of objects in the active drawing area and have the top of the objects aligned together.

**Modify > Align > Middle**

The *Middle* command allows you to select a group of objects in the active drawing area and have all of the objects aligned to horizontal middle.

**Modify > Align > Bottom**

The *Bottom* command allows you to select a group of objects in the active drawing area and have the bottom of the objects aligned together.

**Modify > Align > Left**

The *Left* command allows you to select a group of objects in the active drawing area and have all of the objects aligned to the left.

**Modify > Align > Center**

The *Center* command allows you to select a group of objects in the active drawing area and have all of the objects aligned to vertical center.



**Modify > Align > Right**

The *Right* command allows you to select a group of objects in the active drawing area and have all of the objects aligned to the right.

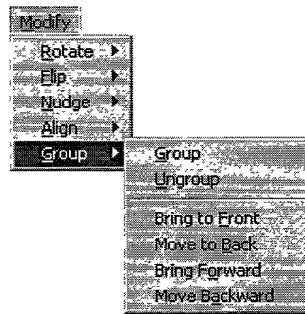


Figure 26 – Group Submenu Commands

**Modify > Group**

The *Group* command allows you to select a group of objects in the active drawing area and group the objects into a single entity or the ability to select a grouped object and ungroup them into their original components.

**Modify > Group > Group**

The *Group* command allows you to select a group of objects in the active drawing area and group the objects into a single entity.

**Modify > Group > Ungroup**

The *Group* command allows you to select a grouped object in the active drawing area and ungroup the objects back to their stand alone state.

**Modify > Group > Bring to Front**

Not Currently Implemented

**Modify > Group > Move to Back**

Not Currently Implemented

**Modify > Group > Bring Forward**

Not Currently Implemented

**Modify > Group > Move Backward**

Not Currently Implemented





# Layer Menu



Figure 27 – Layer Menu Command

**Layer Manager**  
The *Layer Manager* command brings up the Layer Manager dialog box as shown in Figure 27.

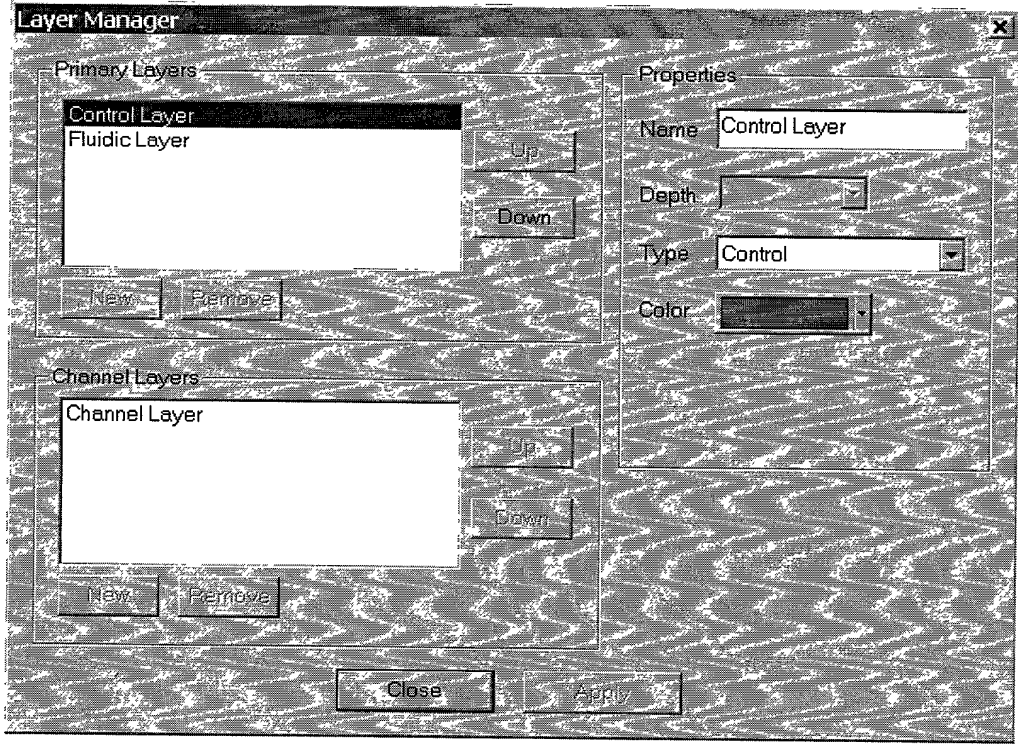


Figure 28 – Layer Manager Dialog

## Primary Layers

The *Primary Layers* section of the dialog box shown in Figure 28 shows the total number of layers present in the design. Currently it is not possible to change the *Name* nor the *Depth* of these primary layers. You can change the color of the layers in the *Properties* section of the dialog box once the primary layer is selected. Click on the *Apply* button after any changes are made to save the changes.

## Channel Layers

The *Channel Layers* section of the dialog box shown in Figure 28 shows the total number of channel depths available in one primary layer. Currently this is set to one channel depth per primary layer. You can change the name of the channel layer by left clicking on the layer name to select it in the Channel Layers section of the dialog and then entering in a new name in the *Properties* section. Click on the *Apply* button after any changes are made to save the changes. Also note that the channel depth is shown for the layer once it has been selected.



| Table 1. Demographic characteristics of the study population |                 |
|--|-----------------|
| Age (years)  | 65.0 ± 1.5      |
| Gender   |                 |
| Male   | 50.0%           |
| Female   | 50.0%           |
| Education (years)  | 12.0 ± 1.0      |
| Marital status   |                 |
| Married  | 60.0%           |
| Single   | 40.0%           |
| Income (USD/month)   | 1,200.0 ± 200.0 |
| Health status  |                 |
| Good   | 70.0%           |
| Poor   | 30.0%           |
| Smoking status   |                 |
| Smoker   | 20.0%           |
| Non-smoker   | 80.0%           |
| Alcohol consumption  |                 |
| Drinker  | 10.0%           |
| Non-drinker  | 90.0%           |

## ***File* Toolbar**

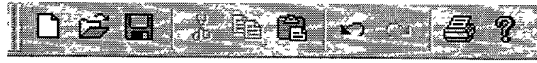












Figure 31 – File Toolbar

| <b>Toolbar Command</b>  | <b>Command</b>  |
|---|---|
|    | <i>New</i> – Opening a new design database and starts the Design Wizard to walk you through the setup.  |
|    | <i>Open</i> – Opens an existing design database.  |
|    | <i>Save</i> – Saves the design database of the active drawing window.   |
|    | <i>Cut</i> – Cuts any selected object(s) in the active drawing window and saves it to the system clipboard.   |
|    | <i>Copy</i> – Copies any selected object(s) in the active drawing window and saves it to the system clipboard.  |
|    | <i>Paste</i> – Pastes a item from the system clipboard into the active drawing window. Note: It is not advisable to paste objects other than those cut or copied from the FluidArchitect application. |
|    | <i>Undo</i> – Undoes the last command performed. Repeated undo can be performed.  |
|    | <i>Redo</i> – Redoes the last undo command.   |
|  | <i>Print</i> – Prints a scaled copy of the design to the printer. The scaled design will be scaled to best fit the standard size printer page.  |
|  | <i>Help</i> – Brings up the “About FluidArchitect” dialog with the release information.   |

### Table 1 – File Toolbar Commands

## Drawing Toolbar



Figure 32 – Drawing Toolbar













| Toolbar Command   | Command  |
|---|--|
|  | <i>Select</i> – Opening a new design database and starts the Design Wizard to walk you through the setup.  |
|  | <i>Group</i> – Groups selected objects in the active drawing window.   |
|  | <i>Ungroup</i> – Ungroups objects that were previously grouped together using the <i>Group</i> command.  |
|  | <i>Properties</i> – Displays the properties of a selected component/channel in the active drawing window.  |
|  | <i>Draw Channel</i> – Places the mode of the active drawing window in the mode of drawing channels. Once this command is selected the tool remains in this mode until it is unselected through selecting another command. Right clicking twice in the active drawing area will switch the mode of the drawing area back to the <i>Select</i> mode. |
|  | <i>Text</i> – The text tool can be used to place notes in the active drawing window. Note: Text is NOT rendered onto the final output of the chip design.  |





Figure 32 – Zoom Pan Toolbar






| Toolbar Command   | Command   |
|---|---|
|  | <b>Zoom</b> – This command places the active drawing window in the zoom mode and the cursor becomes a magnifying glass icon. Click and hold the left mouse button and drag to form a rectangle over the area you wish to zoom into. |
|  | <b>Zoom in 25%</b> – This command zooms in the active drawing area in by 25%.   |
|  | <b>Zoom out 25</b> – This command zooms out the active drawing area by 25%.   |
|  | <b>Zoom to Fit</b> – This command zooms the active drawing area to fit the entire chip to the display area.   |
|  | <b>Zoom to Selection</b> – This command zooms the active drawing area to fit the selected objects to the display area.  |
|  | <b>Pan</b> – This command places the active drawing window in the pan mode and the cursor becomes a hand icon. Click and hold the left mouse button to pan the active drawing area in the direction desired.                        |

### Table 3 – Zoom Pan Toolbar Commands

## Rotate Toolbar



Figure 33 – Rotate Toolbar







| Toolbar Command   | Command  |
|---|--|
|  | <i>Rotate</i> – The command is used to freely rotate a selected object in the active drawing area. Note: This command should be used carefully as freely rotating objects can cause the connecting point/ports to become “off-grid” making it impossible to connect other components and channels to it. |
|  | <i>Rotate Left</i> – This command rotates a selected object in the active drawing area 90 degrees counter clockwise.   |
|  | <i>Rotate Right</i> – This command rotates a selected object in the active drawing area 90 degrees clockwise.  |
|  | <i>Flip Vertical</i> – This command flips a selected object in the active drawing about its vertical center axis.  |
|  | <i>Flip Horizontal</i> – This command flips a selected object in the active drawing about its horizontal center axis.  |

#### Table 4 – Rotate Toolbar Commands

## Align Toolbar

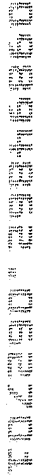


Figure 34 – Align Toolbar

| Toolbar Command   | Command  |
|---|--|
|  | <i>Align Top</i> – The <i>Top</i> command allows you to select a group of objects in the active drawing area and have the top of the objects aligned together.               |
|  | <i>Align Middle</i> – The <i>Middle</i> command allows you to select a group of objects in the active drawing area and have all of the objects aligned to horizontal middle. |
|  | <i>Align Bottom</i> – The <i>Bottom</i> command allows you to select a group of objects in the active drawing area and have the bottom of the objects aligned together.      |
|  | <i>Align Left</i> – The <i>Left</i> command allows you to select a group of objects in the active drawing area and have all of the objects aligned to the left.              |
|  | <i>Align Center</i> – The <i>Center</i> command allows you to select a group of objects in the active drawing area and have all of the objects aligned to vertical center.   |
|  | <i>Align Right</i> – The <i>Right</i> command allows you to select a group of objects in the active drawing area and have all of the objects aligned to the right.           |

| Table 1. Demographic characteristics of the study population |             |
|--|-------------|
| Age (years)  | 65.0 ± 1.5  |
| Gender   |             |
| Male   | 50 (50.0%)  |
| Female   | 50 (50.0%)  |
| Education (years)  | 12.0 ± 1.0  |
| Marital status   |             |
| Married  | 40 (80.0%)  |
| Single   | 10 (20.0%)  |
| Occupation   |             |
| Retired  | 30 (60.0%)  |
| Unemployed   | 20 (40.0%)  |
| Income (USD/month)   | 1,200 ± 200 |
| Health status  |             |
| Good   | 30 (60.0%)  |
| Poor   | 20 (40.0%)  |
| Comorbidities  |             |
| Hypertension   | 15 (30.0%)  |
| Diabetes   | 10 (20.0%)  |
| Cholesterol  | 12 (24.0%)  |
| Arthritis  | 8 (16.0%)   |
| Other  | 5 (10.0%)   |

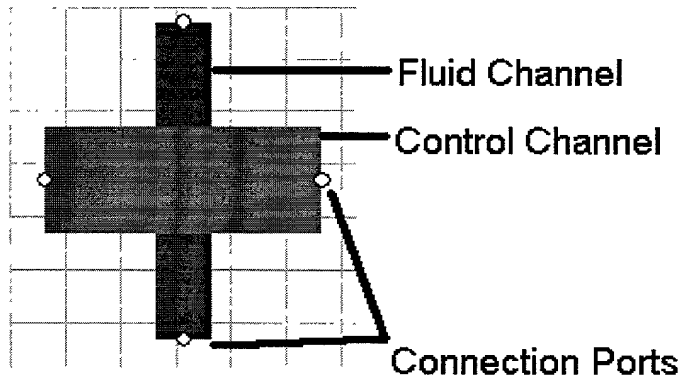
Once the proper component is found, left click the mouse button and hold and drag the component into the active drawing area and release the button to place the component.



| Table 1. Demographic characteristics of the study population |             |
|--|-------------|
| Age (years)  | 65.0 ± 1.5  |
| Gender   |             |
| Male   | 50 (50.0%)  |
| Female   | 50 (50.0%)  |
| Education (years)  | 12.0 ± 1.0  |
| Marital status   |             |
| Married  | 40 (80.0%)  |
| Single   | 10 (20.0%)  |
| Occupation   |             |
| Retired  | 30 (60.0%)  |
| Unemployed   | 20 (40.0%)  |
| Income (USD/month)   | 1,200 ± 200 |
| Health status  |             |
| Good   | 30 (60.0%)  |
| Poor   | 20 (40.0%)  |
| Comorbidities  |             |
| Hypertension   | 15 (30.0%)  |
| Diabetes   | 10 (20.0%)  |
| Cholesterol  | 12 (24.0%)  |
| Arthritis  | 8 (16.0%)   |
| Depression   | 5 (10.0%)   |
| Medication   |             |
| Antidepressants  | 10 (20.0%)  |
| Antipsychotics   | 5 (10.0%)   |
| Mood stabilizers   | 3 (6.0%)    |
| Other  | 7 (14.0%)   |
| Alcohol consumption  |             |
| Regular  | 5 (10.0%)   |
| Occasional   | 15 (30.0%)  |
| Never  | 30 (60.0%)  |
| Smoking status   |             |
| Current  | 10 (20.0%)  |
| Former   | 15 (30.0%)  |
| Never  | 25 (50.0%)  |

### Library Component Characteristics

### Library Component Characteristics



**Figure 37 – Typical Library Component and Characteristics**

The blue line represents a fluid channel present on the *Fluidic* layer while the red line represents a channel on the *Control* layer. The connection ports are points where connections from other components or drawn channels can legally be connected to the component.

**Note:** Channel or component connections to connection ports of components **MUST** be members of the same layer.

| Sociodemographic characteristics |             |
|----------------------------------|-------------|
| Age (years)                      | 18-24       |
| Gender                           | Male        |
| Marital status                   | Married     |
| Occupation                       | Unemployed  |
| Education                        | High school |
| Income                           | Low         |
| Health status                    | Good        |
| Smoking status                   | Non-smoker  |
| Alcohol consumption              | Non-drinker |
| Exercise                         | Regular     |
| Stress                           | Low         |
| Family size                      | Small       |
| Religion                         | Muslim      |
| City                             | Baghdad     |
| Time of day                      | Daytime     |
| Season                           | Summer      |
| Weather                          | Sunny       |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
| Humidity                         | Low         |
| Wind speed                       | Low         |
| Air quality                      | Good        |
| Noise level                      | Low         |
| Light intensity                  | High        |
| Temperature                      | High        |
|                                  |             |

Figure 38 shows the Layer Manager window and the highlights the information available from the Layer Manager window.

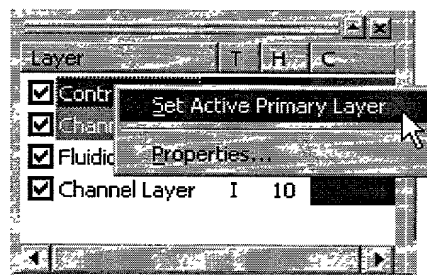


Figure 38 – Layer Manager

The default layer color is blue for the fluidic layer and red for the control layer. These colors can be changed to suit your preference.

As mentioned above, the “Active Primary Layer” can be set through the Library Manager. Figure 39 shows the pop up after selecting the *Control* or *Fluidic* layer by left clicking to select it in the Layer Manager. Once selected, right clicking will bring up a pop up dialog box allowing you the ability to set the layer to be active.

- Drawing of channels onto that layer.
- Selecting channels or components that are on that layer and performing actions on those selected.
- Changing the color of the layer. Any new color selected will replace the existing color for all components and channels in that layer.



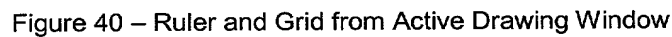
**Figure 39 – Setting the Active Primary Layer**



| Variable             | Mean        | SD         | Min | Max |
|----------------------|-------------|------------|-----|-----|
| Age                  | 34.5        | 10.2       | 21  | 55  |
| Gender               | Male        | Female     |     |     |
| Marital Status       | Married     | Single     |     |     |
| Education            | High School | College    |     |     |
| Occupation           | Manager     | Worker     |     |     |
| Income               | \$10,000    | \$20,000   |     |     |
| Health Status        | Good        | Fair       |     |     |
| Exercise Frequency   | Weekly      | Monthly    |     |     |
| Stress Level         | Low         | High       |     |     |
| Sleep Quality        | Good        | Poor       |     |     |
| Dietary Habits       | Healthy     | Unhealthy  |     |     |
| Alcohol Consumption  | None        | Occasional |     |     |
| Tobacco Use          | Non-smoker  | Smoker     |     |     |
| Family Size          | 2           | 3          |     |     |
| Home Ownership       | Renter      | Owner      |     |     |
| Commute Time         | 15 min      | 30 min     |     |     |
| Work Hours           | 40 hrs      | 50 hrs     |     |     |
| Job Satisfaction     | High        | Low        |     |     |
| Life Satisfaction    | High        | Low        |     |     |
| Overall Health Score | 75          | 15         | 50  | 100 |

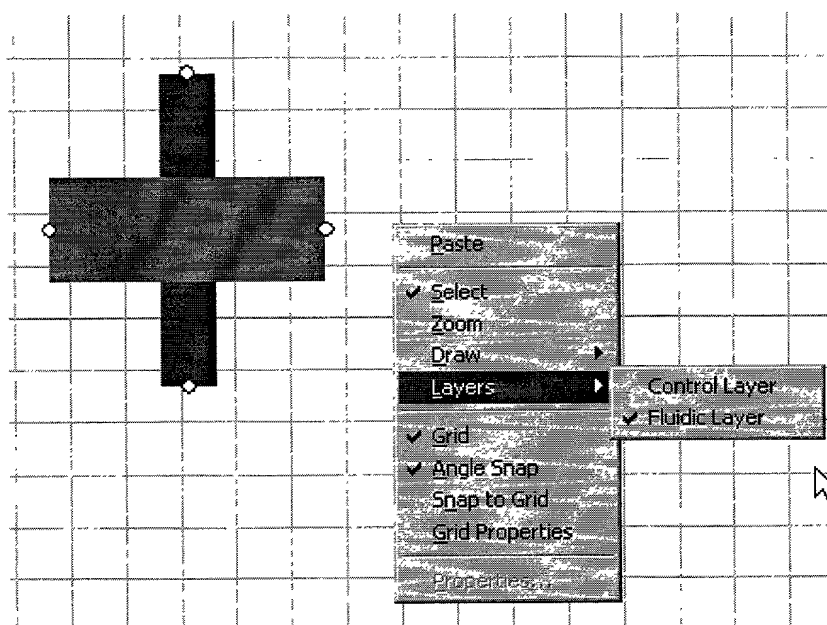
## Rulers and Grid

The lower right hand corner represents the (20000, 20000) position. These position numbers also translate into real measures as they are represented in microns. The grid color and the interval of grid lines can be changed using the *Grid Properties* command from the *View* menu.



The active drawing area has right click pop up menus based on the function that is currently selected. There are two different pop up menus, one for the Select tool and the other for a selected component.

The pop up menu contains some of the most frequently used commands from the tool bar with the addition of the *Layers* command. The *Layers* command can be used to set active the layer you need to draw on without having to go to the Layer Manager. Figure 41 shows the submenu to select and set active a layer.



**Figure 42 – Layer Submenu Selection**

The check mark next to the layer name indicates the layer that is currently selected.

### Selected Component/Channel Pop Up Menu

Once a component(s) or channel(s) is selected in active drawing area, a right click will pop up a menu to allow functions or commands to be performed on the selected objects.. The pop up menu is context sensitive in that a selected component will bring up a different pop up menu as opposed to a selected channel. Figure 43 shows a component selected and the pop



commands available. The function descriptions can be found in the Main Menu or Toolbar commands with the exception of the *Properties...* command

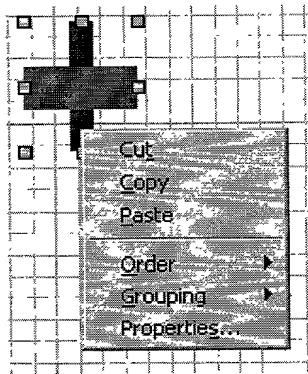


Figure 43 – Selected Component Pop Up Menu

Figure 44 shows a channel selected and the pop up menu with its available commands. Notice here the addition of the *Channel Widths* command. The Channel Widths command allows quick modifications of the drawn channels so that matching to connected components or channels is easily facilitated. Figure X shows an example where a channel drawn at 50  $\mu\text{m}$  needs to be connected to a pump control element that is 200  $\mu\text{m}$  in width.

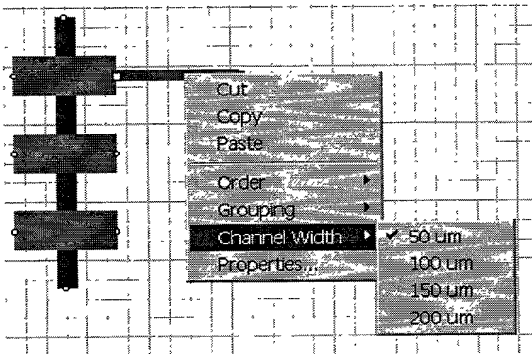


Figure 44 – Selected Channel Pop Up Menu

### Status Bar

The Status Bar has two modes. One mode is when the drawing area is in the *Select* mode and the other is in the channel drawing mode.

### Select Mode

In the *Select* mode the status bar contains the following information:

- Left Status Box: Component Name
- Center Status Box: Absolute Cursor Location (in microns)
- Right Status Box: Percentage Zoomed In

Figure 45 shows the Status Bar while in the select mode.



| Component<br>Name | Cursor<br>Location | %<br>Zoom |
|-------------------|--------------------|-----------|
|-------------------|--------------------|-----------|

Figure 45 – Status Bar in Select Mode

## Drawing Mode

In the *Drawing* mode the status bar contains the following information:

- Left Status Box: Length of channel drawn (in microns)
- Center Status Box: Absolute Cursor Location (in microns)
- Right Status Box: Percentage Zoomed In

Figure 46 shows the Status Bar while in the select mode. Notice as you start drawing the channel the status bar is updated with the length of the channel drawn.

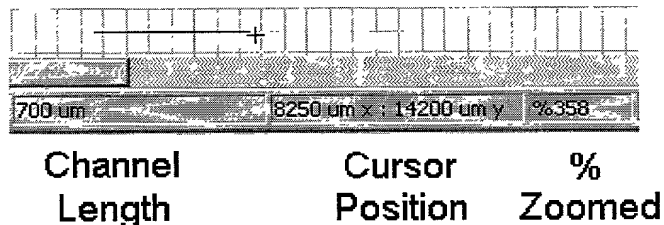


Figure 46 – Status Bar in Drawing Mode

| Health Characteristics    |                        | Treatment   |              |
|---------------------------|------------------------|-------------|--------------|
|                           |                        | Control     | Intervention |
| Age                       | Mean (SD)              | 47.8 (10.2) | 47.8 (10.2)  |
| Gender                    | % Male                 | 50.0        | 50.0         |
| Marital Status            | % Married              | 60.0        | 60.0         |
| Education                 | % High School Graduate | 70.0        | 70.0         |
| Income                    | % < \$10,000           | 30.0        | 30.0         |
| Health Insurance          | % Private              | 40.0        | 40.0         |
| Smoking                   | % Current              | 20.0        | 20.0         |
| Alcohol                   | % Heavy                | 10.0        | 10.0         |
| Exercise                  | % Regular              | 15.0        | 15.0         |
| Stress                    | % High                 | 25.0        | 25.0         |
| Family History            | % Heart Disease        | 10.0        | 10.0         |
| Comorbidities             | % Hypertension         | 15.0        | 15.0         |
| Medication                | % on Medication        | 10.0        | 10.0         |
| Healthcare Access         | % Regular Visits       | 20.0        | 20.0         |
| Healthcare Costs          | % High                 | 15.0        | 15.0         |
| Healthcare Satisfaction   | % Satisfied            | 30.0        | 30.0         |
| Healthcare Quality        | % High                 | 20.0        | 20.0         |
| Healthcare Safety         | % High                 | 15.0        | 15.0         |
| Healthcare Effectiveness  | % High                 | 10.0        | 10.0         |
| Healthcare Equity         | % High                 | 5.0         | 5.0          |
| Healthcare Transparency   | % High                 | 5.0         | 5.0          |
| Healthcare Accountability | % High                 | 5.0         | 5.0          |
| Healthcare Innovation     | % High                 | 5.0         | 5.0          |
| Healthcare Sustainability | % High                 | 5.0         | 5.0          |
| Healthcare Resilience     | % High                 | 5.0         | 5.0          |
| Healthcare Adaptability   | % High                 | 5.0         | 5.0          |
| Healthcare Inclusivity    | % High                 | 5.0         | 5.0          |
| Healthcare Diversity      | % High                 | 5.0         | 5.0          |
| Healthcare Collaboration  | % High                 | 5.0         | 5.0          |
| Healthcare Partnership    | % High                 | 5.0         | 5.0          |
| Healthcare Engagement     | % High                 | 5.0         | 5.0          |
| Healthcare Empowerment    | % High                 | 5.0         | 5.0          |
| Healthcare Participation  | % High                 | 5.0         | 5.0          |
| Healthcare Involvement    | % High                 | 5.0         | 5.0          |
| Healthcare Contribution   | % High                 | 5.0         | 5.0          |
| Healthcare Commitment     | % High                 | 5.0         | 5.0          |
| Healthcare Dedication     | % High                 | 5.0         | 5.0          |
| Healthcare Devotion       | % High                 | 5.0         | 5.0          |
| Healthcare Loyalty        | % High                 | 5.0         | 5.0          |
| Healthcare Fidelity       | % High                 | 5.0         | 5.0          |
| Healthcare Allegiance     | % High                 | 5.0         | 5.0          |
| Healthcare Obedience      | % High                 | 5.0         | 5.0          |
| Healthcare Compliance     | % High                 | 5.0         | 5.0          |
| Healthcare Adherence      | % High                 | 5.0         | 5.0          |
| Healthcare Conformity     | % High                 | 5.0         | 5.0          |
| Healthcare Regularity     | % High                 | 5.0         | 5.0          |
| Healthcare Consistency    | % High                 | 5.0         | 5.0          |
| Healthcare Continuity     | % High                 | 5.0         | 5.0          |
| Healthcare Coherence      | % High                 | 5.0         | 5.0          |
| Healthcare Harmony        | % High                 | 5.0         | 5.0          |
| Healthcare Unity          | % High                 | 5.0         | 5.0          |
| Healthcare Solidarity     | % High                 | 5.0         | 5.0          |
| Healthcare Fellowship     | % High                 | 5.0         | 5.0          |
| Healthcare Companionship  | % High                 | 5.0         | 5.0          |
| Healthcare Camaraderie    | % High                 | 5.0         | 5.0          |
| Healthcare Teamwork       | % High                 | 5.0         | 5.0          |
| Healthcare Cooperation    | % High                 | 5.0         | 5.0          |
| Healthcare Collaboration  | % High                 | 5.0         | 5.0          |
| Healthcare Partnership    | % High                 | 5.0         | 5.0          |
| Healthcare Engagement     | % High                 | 5.0         | 5.0          |
| Healthcare Empowerment    | % High                 | 5.0         | 5.0          |
| Healthcare Participation  | % High                 | 5.0         | 5.0          |
| Healthcare Involvement    | % High                 | 5.0         | 5.0          |
| Healthcare Contribution   | % High                 | 5.0         | 5.0          |
| Healthcare Commitment     | % High                 | 5.0         | 5.0          |
| Healthcare Dedication     | % High                 | 5.0         | 5.0          |
| Healthcare Devotion       | % High                 | 5.0         | 5.0          |
| Healthcare Loyalty        | % High                 | 5.0         | 5.0          |
| Healthcare Fidelity       | % High                 | 5.0         | 5.0          |
| Healthcare Allegiance     | % High                 | 5.0         | 5.0          |
| Healthcare Obedience      | % High                 | 5.0         | 5.0          |
| Healthcare Compliance     | % High                 | 5.0         | 5.0          |
| Healthcare Adherence      | % High                 | 5.0         | 5.0          |
| Healthcare Conformity     | % High                 | 5.0         | 5.0          |
| Healthcare Regularity     | % High                 | 5.0         | 5.0          |
| Healthcare Consistency    | % High                 | 5.0         | 5.0          |
| Healthcare Continuity     | % High                 | 5.0         | 5.0          |
| Healthcare Coherence      | % High                 | 5.0         | 5.0          |
| Healthcare Harmony        | % High                 | 5.0         | 5.0          |
| Healthcare Unity          | % High                 | 5.0         | 5.0          |
| Healthcare Solidarity     | % High                 | 5.0         | 5.0          |
| Healthcare Fellowship     | % High                 | 5.0         | 5.0          |
| Healthcare Companionship  | % High                 | 5.0         | 5.0          |
| Healthcare Camaraderie    | % High                 | 5.0         | 5.0          |
| Healthcare Teamwork       | % High                 | 5.0         | 5.0          |
| Healthcare Cooperation    | % High                 | 5.0         | 5.0          |
| Healthcare Collaboration  | % High                 | 5.0         | 5.0          |
| Healthcare Partnership    | % High                 | 5.0         | 5.0          |
| Healthcare Engagement     | % High                 | 5.0         | 5.0          |
| Healthcare Empowerment    | % High                 | 5.0         | 5.0          |
| Healthcare Participation  | % High                 | 5.0         | 5.0          |
| Healthcare Involvement    | % High                 | 5.0         | 5.0          |
| Healthcare Contribution   | % High                 | 5.0         | 5.0          |
| Healthcare Commitment     | % High                 | 5.0         | 5.0          |
| Healthcare Dedication     | % High                 | 5.0         | 5.0          |
| Healthcare Devotion</     |                        |             |              |



FluidArchitect was built with many design rules that are implemented directly into the various parts of the design system. As such, FluidArchitect applies those design rules to your design as you are placing and connecting the components from the libraries in the drawing area. The following are general rules to keep in mind and will help lead to a successful design implementation.

- The Design Wizard walks you through the setup of the design and will allow you to set up the following details of your design:



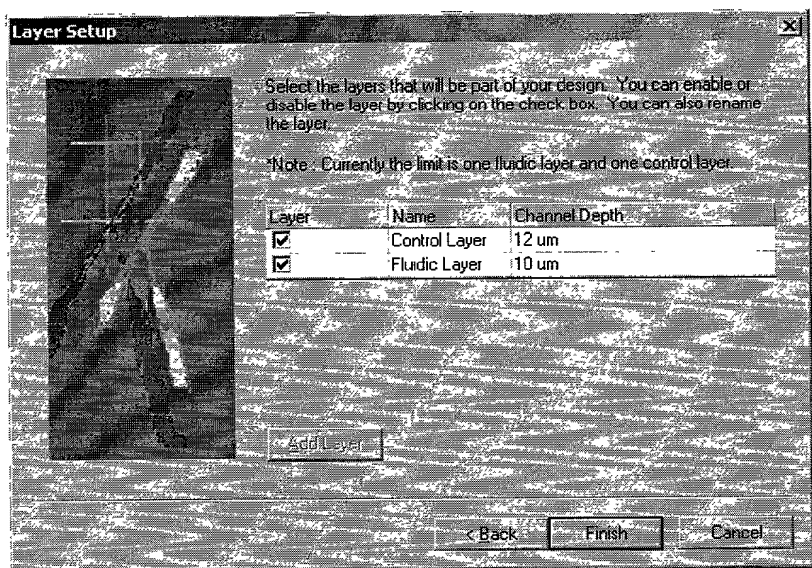
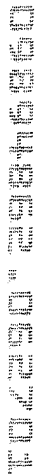


Figure 50 – Layer Selection Wizard Screen

0584862 062701

| Table 1. Demographic characteristics of the study population |             |
|--|-------------|
| Age (years)  | 50.0 ± 10.0 |
| Gender   |             |
| Male   | 50.0%       |
| Female   | 50.0%       |
| Education (years)  | 12.0 ± 2.0  |
| Marital status   |             |
| Married  | 80.0%       |
| Single   | 20.0%       |
| Occupation   |             |
| Professional   | 30.0%       |
| Managerial   | 20.0%       |
| Technical  | 10.0%       |
| Service  | 20.0%       |
| Unemployed   | 20.0%       |
| Income (USD/month)   | 1,500 ± 500 |
| Health status  |             |
| Good   | 70.0%       |
| Fair   | 20.0%       |
| Poor   | 10.0%       |



| Table 1. Demographic characteristics of the study population |             |
|--|-------------|
| Age (years)  | 50.0 ± 10.0 |
| Gender   |             |
| Male   | 50.0%       |
| Female   | 50.0%       |
| Education (years)  | 12.0 ± 2.0  |
| Marital status   |             |
| Married  | 80.0%       |
| Single   | 20.0%       |
| Occupation   |             |
| Professional   | 30.0%       |
| Managerial   | 20.0%       |
| Technical  | 10.0%       |
| Service  | 20.0%       |
| Unemployed   | 20.0%       |
| Income (USD/month)   | 1,500 ± 500 |
| Health status  |             |
| Good   | 70.0%       |
| Fair   | 20.0%       |
| Poor   | 10.0%       |

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| Female   | 50.0%       |
| Education (years)  | 12.0 ± 2.0  |
| Marital status   |             |
| Married  | 80.0%       |
| Single   | 20.0%       |
| Occupation   |             |
| Professional   | 30.0%       |
| Managerial   | 20.0%       |
| Technical  | 10.0%       |
| Service  | 20.0%       |
| Unemployed   | 20.0%       |
| Income (USD/month)   | 1,500 ± 500 |
| Health status  |             |
| Good   | 70.0%       |
| Fair   | 20.0%       |
| Poor   | 10.0%       |

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|--|-------------|
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| Gender   |             |
| Male   | 50.0%       |
| Female   | 50.0%       |
| Education (years)  | 12.0 ± 2.0  |
| Marital status   |             |
| Married  | 80.0%       |
| Single   | 20.0%       |
| Occupation   |             |
| Professional   | 30.0%       |
| Managerial   | 20.0%       |
| Technical  | 10.0%       |
| Service  | 20.0%       |
| Unemployed   | 20.0%       |
| Income (USD/month)   | 1,500 ± 500 |
| Health status  |             |
| Good   | 70.0%       |
| Fair   | 20.0%       |
| Poor   | 10.0%       |

| Table 1. Demographic characteristics of the study population |                 |
|--|-----------------|
| Age (years)  | 50.0 ± 10.0     |
| Gender   |                 |
| Male   | 50.0%           |
| Female   | 50.0%           |
| Education (years)  | 12.0 ± 2.0      |
| Marital status   |                 |
| Married  | 80.0%           |
| Single   | 20.0%           |
| Occupation   |                 |
| Professional   | 30.0%           |
| Managerial   | 20.0%           |
| Technical  | 10.0%           |
| Skilled  | 20.0%           |
| Unskilled  | 20.0%           |
| Income (USD/month)   | 1,500.0 ± 500.0 |
| Health status  |                 |
| Good   | 70.0%           |
| Fair   | 20.0%           |
| Poor   | 10.0%           |

| Table 1. Demographic characteristics of the study population |             |
|--|-------------|
| Age (years)  | 50.0 ± 10.0 |
| Gender   |             |
| Male   | 50.0%       |
| Female   | 50.0%       |
| Education (years)  | 12.0 ± 2.0  |
| Marital status   |             |
| Married  | 80.0%       |
| Single   | 20.0%       |
| Occupation   |             |
| Professional   | 30.0%       |
| Managerial   | 20.0%       |
| Technical  | 10.0%       |
| Service  | 20.0%       |
| Unemployed   | 20.0%       |
| Income (USD/month)   | 1,500 ± 500 |
| Health status  |             |
| Good   | 70.0%       |
| Fair   | 20.0%       |
| Poor   | 10.0%       |



| Variable       | Mean  | Standard Deviation | Minimum | Maximum |
|----------------|-------|--------------------|---------|---------|
| Age            | 34.5  | 10.2               | 22      | 55      |
| Gender         | 0.5   | 0.5                | 0       | 1       |
| Marital Status | 0.7   | 0.5                | 0       | 1       |
| Education      | 12.5  | 1.5                | 10      | 15      |
| Income         | 35000 | 15000              | 15000   | 70000   |
| Health         | 0.8   | 0.4                | 0       | 1       |
| Smoking        | 0.3   | 0.5                | 0       | 1       |
| Alcohol        | 0.2   | 0.4                | 0       | 1       |
| Exercise       | 0.5   | 0.5                | 0       | 1       |
| Stress         | 0.6   | 0.5                | 0       | 1       |
| Sleep          | 0.7   | 0.4                | 0       | 1       |
| Diet           | 0.6   | 0.5                | 0       | 1       |
| Work           | 0.8   | 0.4                | 0       | 1       |
| Family         | 0.7   | 0.5                | 0       | 1       |
| Friends        | 0.6   | 0.5                | 0       | 1       |
| Hobbies        | 0.5   | 0.5                | 0       | 1       |
| Travel         | 0.4   | 0.5                | 0       | 1       |
| Shopping       | 0.3   | 0.5                | 0       | 1       |
| Reading        | 0.2   | 0.4                | 0       | 1       |
| TV             | 0.1   | 0.3                | 0       | 1       |
| Phone          | 0.05  | 0.2                | 0       | 1       |
| Internet       | 0.02  | 0.1                | 0       | 1       |
| Car            | 0.1   | 0.3                | 0       | 1       |
| House          | 0.05  | 0.2                | 0       | 1       |
| Boat           | 0.01  | 0.1                | 0       | 1       |
| Plane          | 0.005 | 0.05               | 0       | 1       |
| Yacht          | 0.001 | 0.01               | 0       | 1       |
| Art            | 0.005 | 0.05               | 0       | 1       |
| Music          | 0.005 | 0.05               | 0       | 1       |
| Golf           | 0.001 | 0.01               | 0       | 1       |
| Tennis         | 0.001 | 0.01               | 0       | 1       |
| Baseball       | 0.001 | 0.01               | 0       | 1       |
| Football       | 0.001 | 0.01               | 0       | 1       |
| Basketball     | 0.001 | 0.01               | 0       | 1       |
| Hockey         | 0.001 | 0.01               | 0       | 1       |
| Boxing         | 0.001 | 0.01               | 0       | 1       |
| Swimming       | 0.001 | 0.01               | 0       | 1       |
| Fishing        | 0.001 | 0.01               | 0       | 1       |
| Gardening      | 0.001 | 0.01               | 0       | 1       |
| Cooking        | 0.001 | 0.01               | 0       | 1       |
| Cleaning       | 0.001 | 0.01               | 0       | 1       |
| Shopping       | 0.001 | 0.01               | 0       | 1       |
| Travel         | 0.001 | 0.01               | 0       | 1       |
| Reading        | 0.001 | 0.01               | 0       | 1       |
| TV             | 0.001 | 0.01               | 0       | 1       |
| Phone          | 0.001 | 0.01               | 0       | 1       |
| Internet       | 0.001 | 0.01               | 0       | 1       |
| Car            | 0.001 | 0.01               | 0       | 1       |
| House          | 0.001 | 0.01               | 0       | 1       |
| Boat           | 0.001 | 0.01               | 0       | 1       |
| Plane          | 0.001 | 0.01               | 0       | 1       |
| Yacht          | 0.001 | 0.01               | 0       | 1       |
| Art            | 0.001 | 0.01               | 0       | 1       |
| Music          | 0.001 | 0.01               | 0       | 1       |
| Golf           | 0.001 | 0.01               | 0       | 1       |
| Tennis         | 0.001 | 0.01               | 0       | 1       |
| Baseball       | 0.001 | 0.01               | 0       | 1       |
| Football       | 0.001 | 0.01               | 0       | 1       |
| Basketball     | 0.001 | 0.01               | 0       | 1       |
| Hockey         | 0.001 | 0.01               | 0       | 1       |
| Boxing         | 0.001 | 0.01               | 0       | 1       |
| Swimming       | 0.001 | 0.01               | 0       | 1       |
| Fishing        | 0.001 | 0.01               | 0       | 1       |
| Gardening      | 0.001 | 0.01               | 0       | 1       |
| Cooking        | 0.001 | 0.01               | 0       | 1       |
| Cleaning       | 0.001 | 0.01               | 0       | 1       |
| Shopping       | 0.001 | 0.01               | 0       | 1       |
| Travel         | 0.001 | 0.01               | 0       | 1       |
| Reading        | 0.001 | 0.01               | 0       | 1       |
| TV             | 0.001 | 0.01               | 0       | 1       |
| Phone          | 0.001 | 0.01               | 0       | 1       |
| Internet       | 0.001 | 0.01               | 0       | 1       |
| Car            | 0.001 | 0.01               | 0       | 1       |
| House          | 0.001 | 0.01               | 0       | 1       |
| Boat           | 0.001 | 0.01               | 0       | 1       |
| Plane          | 0.001 | 0.01               | 0       | 1       |
| Yacht          | 0.001 | 0.01               | 0       | 1       |
| Art            | 0.001 | 0.01               | 0       | 1       |
| Music          | 0.001 | 0.01               | 0       | 1       |
| Golf           | 0.001 | 0.01               | 0       | 1       |
| Tennis         | 0.001 | 0.01               | 0       | 1       |
| Baseball       | 0.001 | 0.01               | 0       | 1       |
| Football       | 0.001 | 0.01               | 0       | 1       |

- Ports are shown on components as black outlined white circles.
- Ports once successfully connected they appear as black filled circles. See Figure 53.
- Zooming in can help identify the ports on components and channels.



Drawing channels to connect to other channels and components can be accomplished using the Draw Channel tool. Components are built up using channels in specific placement and physical dimensions. Thus, drawing channels to connect to components is the same as connecting to other drawn channels. The following are guidelines to keep in mind while drawing channels to make connections:



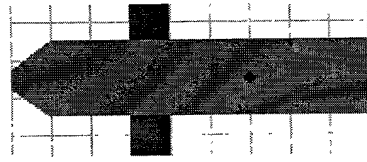


Figure 54.a Channel Port Not Detected, b. Channel Port Detected, c. Channel Connected to Port

## Input and Output Ports

The input and output ports, more commonly referred to as “I/O’s”, are the large circular figures on the template of the chip. Typically the I/O’s are found near the perimeter of the chip. The I/O’s are predetermined based on the template chosen in the Design Wizard.

I/O Ports are used to accomplish the following:

- Provide connections to fluid and material input and output from the chip.
- Provide connections to the control channels to input control signals such as air pressure.

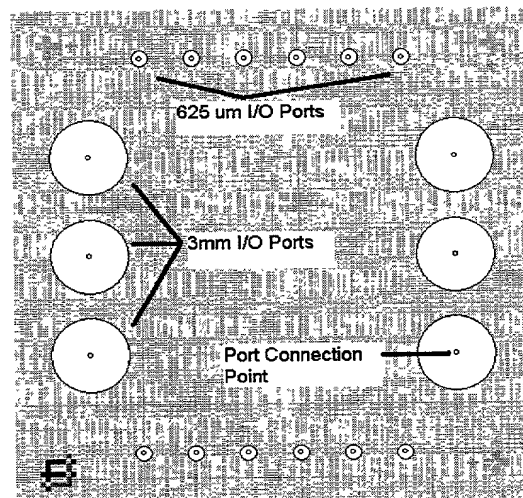


Figure 55 – Chip Template with 6 – 3mm and 12 – 625um I/O Ports

Figure 55 also shows a typical chip template with a preset I/O configuration. The connection point for each of the ports is illustrated in the figure as well. The connection point is the smaller concentric circle that is inside of the port. Connecting a channel to a port can be accomplished by drawing a channel from a channel and when the target tool is engaged over the port, double left clicking the mouse will attach the to the I/O. Once successfully connected to the I/O, the I/O will turn blue and the inner circle will become a filled black circle. Figure 56 shows a connected I/O.

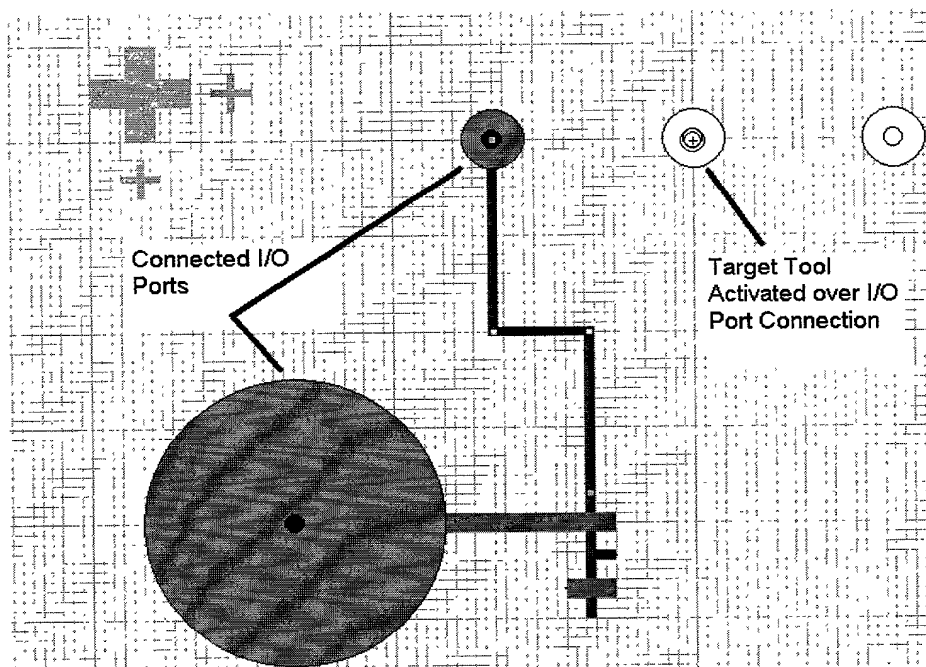


Figure 56 – Connected and Unconnected I/O Ports

## Channel Properties

Components and channels can be assigned user defined names by accessing the Properties sheet for the component or channel. Channel Properties can be used to accomplish the following:

- Change Channel Instance Names
- Change Channel Widths (Fluidic and Control)
- List the connections to other components or channels

Figure 57 shows the channel dialog box for a selected control channel. You can change the width to any value in the drop down box as well as assign a new name to the channel. The channel is not currently connected to any other channel or component so the *Connections* list is empty.

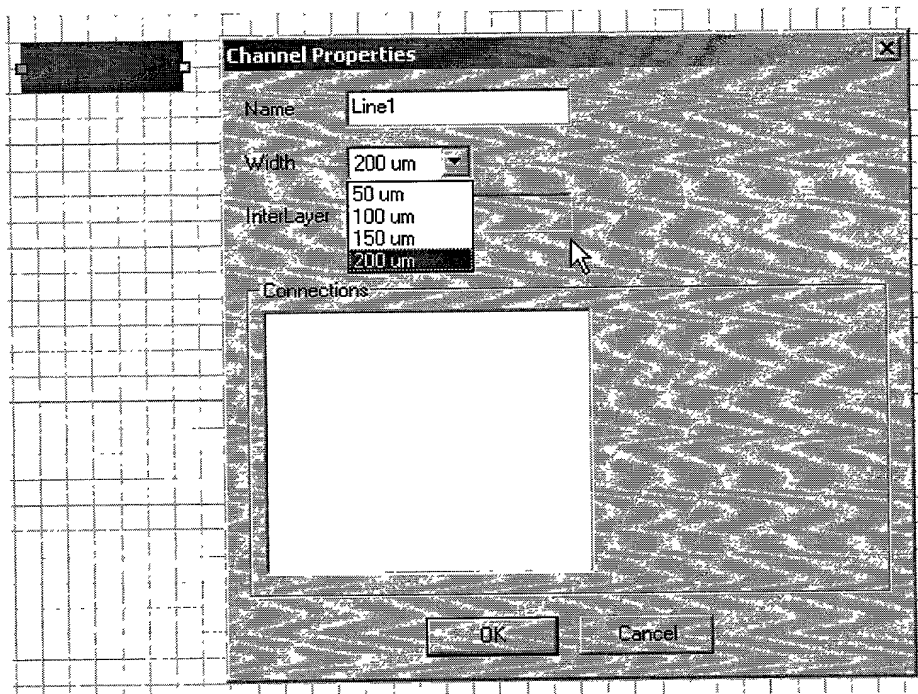


Figure 57 – Channel Properties Dialog Box

## Component Properties

Library components are assigned a default name in the design. You can assign your own instance name to these components, as well as I/O's, to help identify them in the design.

Figure 58 shows a selected T-Switch that was placed from the library. To bring up the Properties dialog box do the following:

- Right click on the T-Switch and select *Properties...*

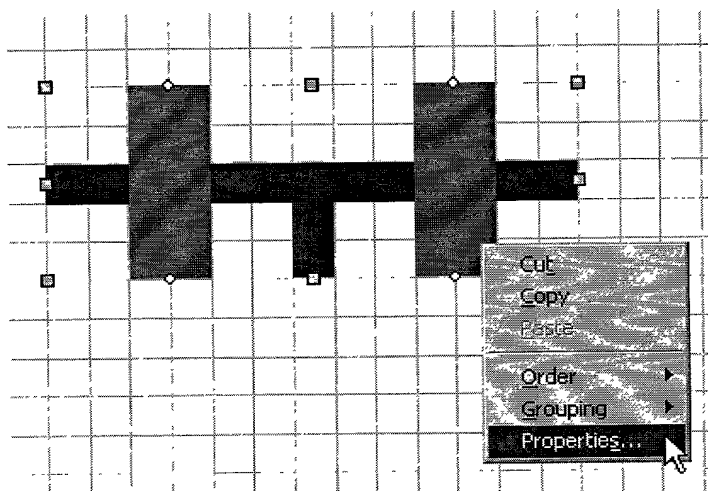


Figure 58 – Select a component and view properties

- The Component Properties dialog box will appear. In this case, this component has been named "My\_T-switch". Figure 59 shows that type of component as well as two other tabs that contains placement information regarding the component.

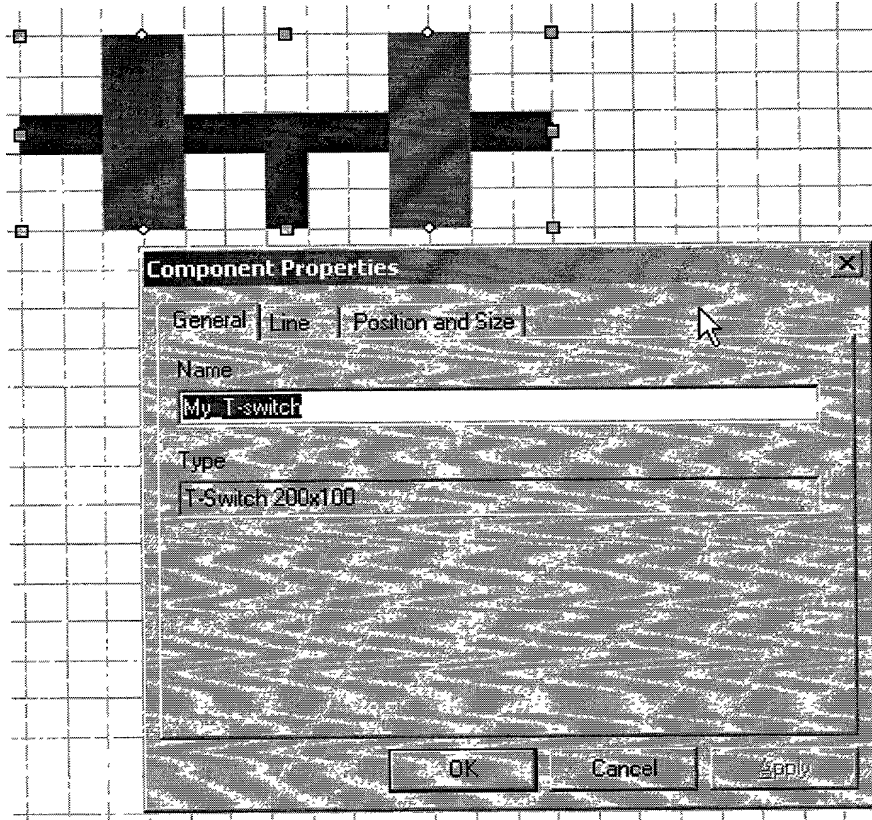


Figure 59 – Component Instance Property Dialog Box

## Design Example

In the following design example a simple cell sorter, shown in Figure 60, is created using FluidArchitect. The pump drives into a T-Switch. The T-Switch is used to drive the fluid/material flow into one of two ports based on the detection region feedback to a system, which monitors and controls the flow. The design will illustrate the methods and procedures used to create the design in FluidArchitect.

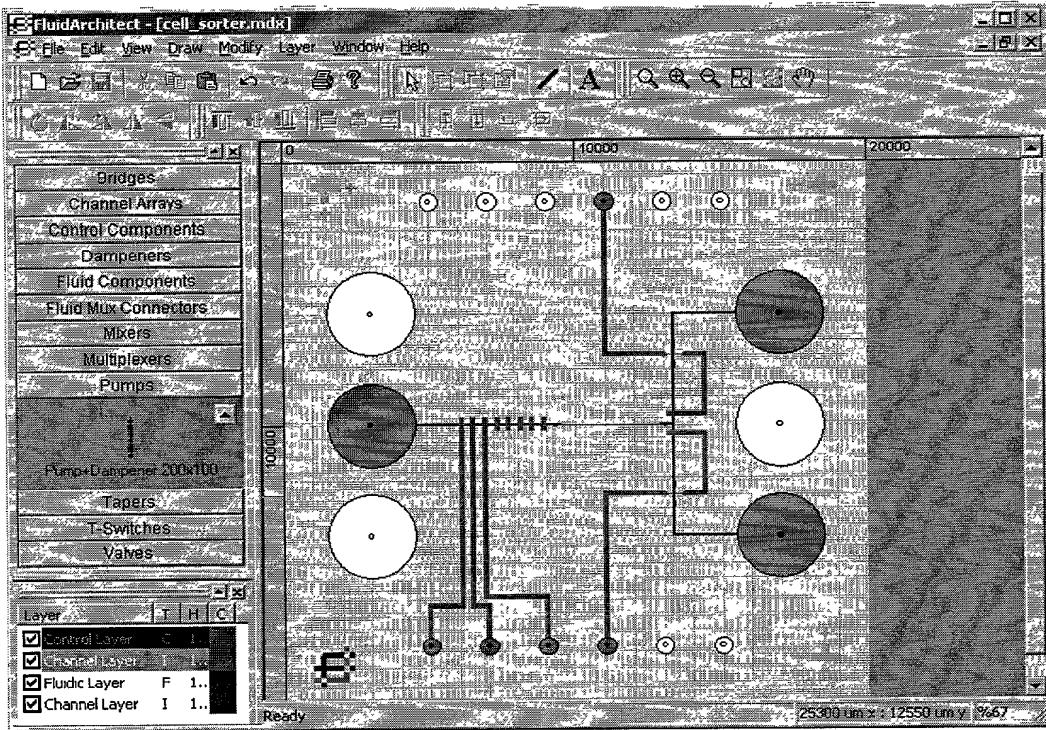


Figure 60 – Completed Design of the Simple Cell Sorter

## Components Required

The components required to construct the simple cell sorter are:

- 1 - Peristaltic Pump
- 1 - T-Sorter
- 2 – 30  $\mu$ m–100  $\mu$ m Fluidic Tapers
- 2 – Bridges
- 3 – 3 mm I/O Ports
- 5 – 625  $\mu$ m I/O Ports

## Basic Operation of the Design

Figure 61 shows the pump, T-Sorter, and the bridges connected in the drawing area. There are many ways to connect the components together and if the design rules are not violated the design will be valid.

Figure 61 also points out a “Detection Region”. This region can be used by an optical detection system to control the direction of the flow through the T-Sorter. The detection region is not a component from the library but rather a user drawn 30  $\mu$ m fluidic channel connecting fluidic taper components forming the region.

Cells are pumped through the channel from the 3mm input port on the left side of the chip using the three control valves and five damping elements that constitutes the pump. An

external detection system, such as an optical measuring system, detects cells as they flow through the "Detection Region". The cells can be directed in either direction to the 3mm output ports by actuation of the T-sorter valve switches. The Bridge components are used to enable the crossing of fluid lines by control lines without creating a parasitic valve. The Bridge components were used in this design to create an area clear of channels for the "Detection Region".

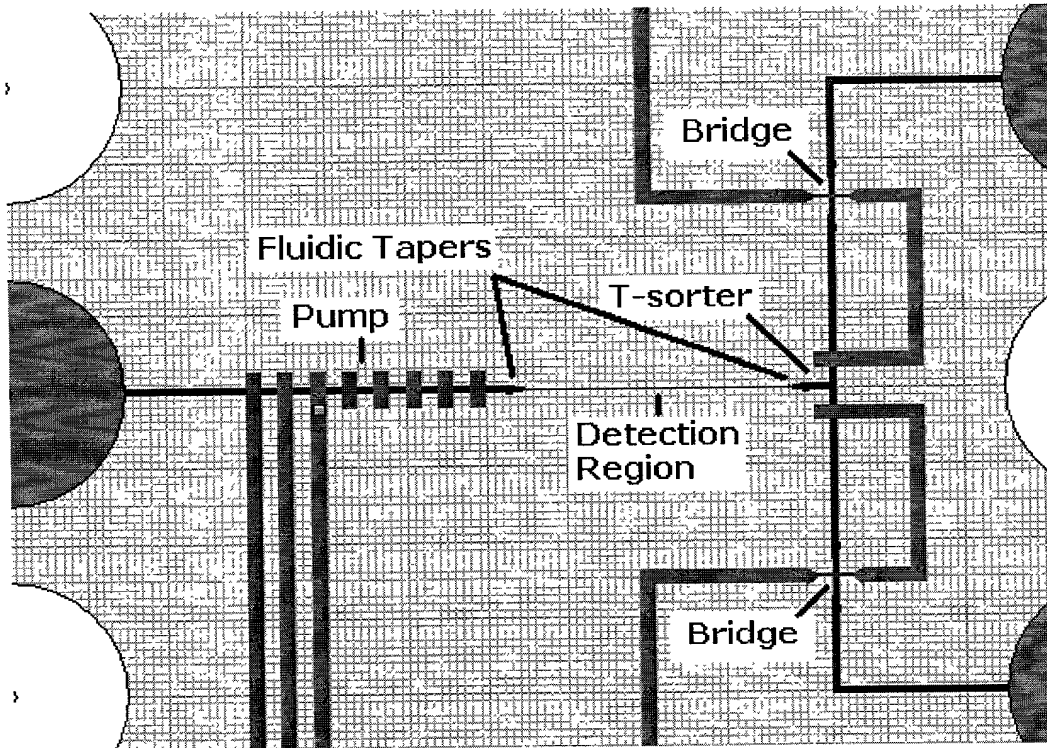


Figure 61 – Components of the Simple Cell Sorter

## Creating the Design

Start the design by launching FluidArchitect from the *Start* menu > *FluidArchitect* > *FluidArchitect* on your PC.

Once the FluidArchitect is started, the next step is to select *File* menu > *New*. The design wizard will start and guide you through the setup for a new design.

## Design Wizard Setup

The Figure 62 shows the Design Wizard screens as they appear in order querying for selections. Carefully read the screens shown by the Design Wizard to appropriately setup the design. Failure to setup the design correctly could lead to reiterations of the design to get the desired results.



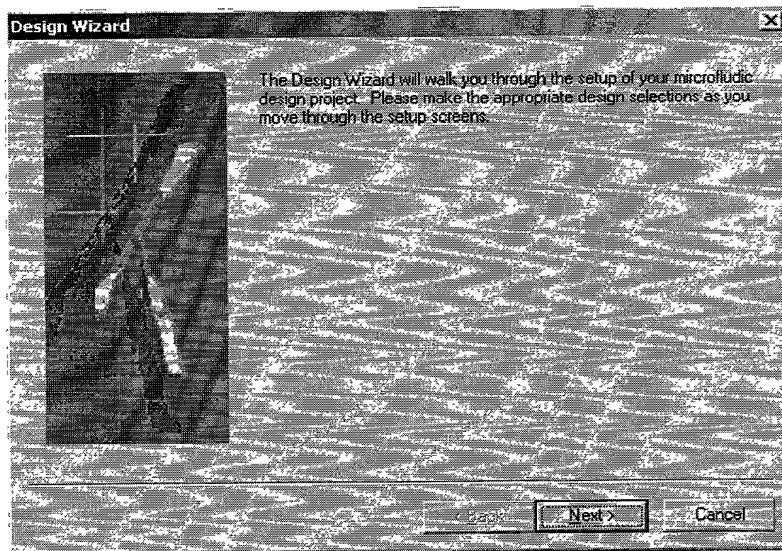


Figure 62 – First Design Wizard Screen

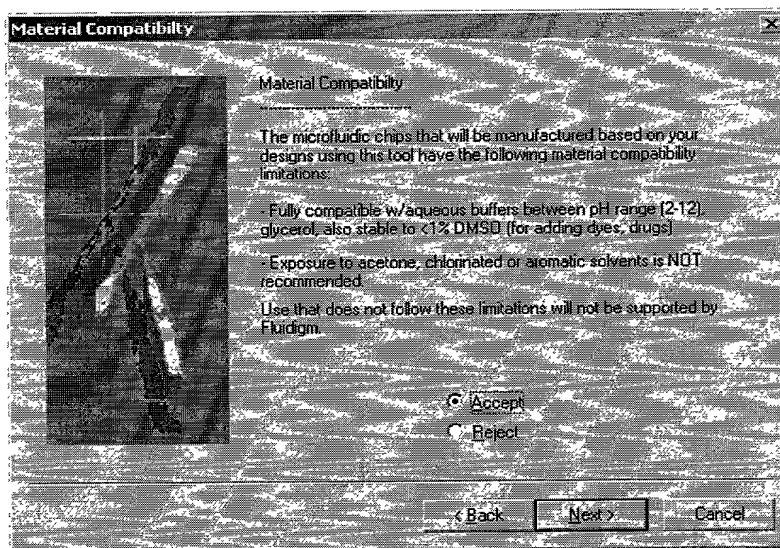


Figure 63 – Material Compatibility Design Wizard Screen

The material compatibility screen warns you to the materials that can and cannot be used with the microfluidic chips that are designed with the FluidArchitect system and fabricated by Fluidigm. Selecting “Accept” will allow you move forward with the design setup. If your needs are not met and you “Reject” the Design Wizard will not go forward. Please contact the factory for more details regarding your special needs.

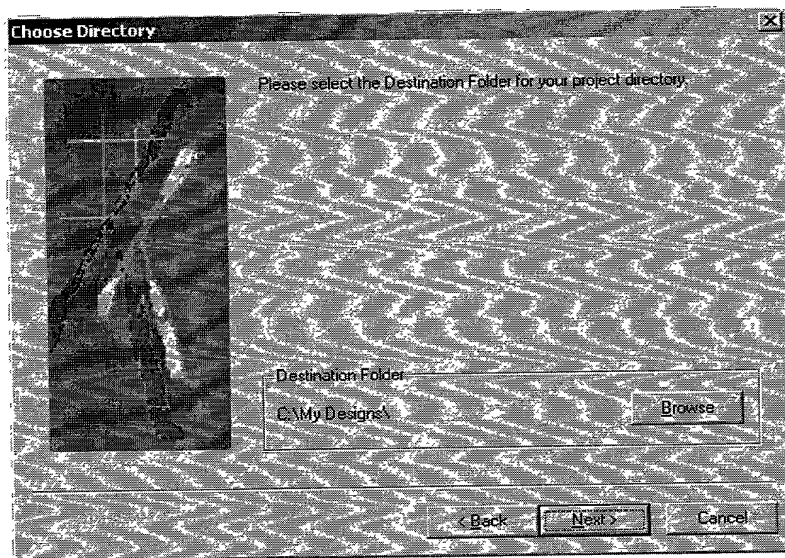


Figure 64 – Project Directory Selection

The Project Directory selection screen simply selects the directory where your design database will be stored.

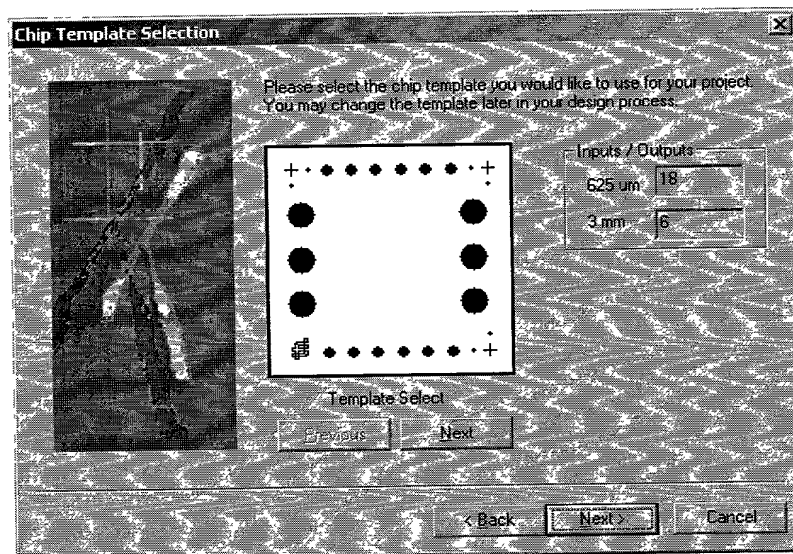


Figure 65 – Chip Template Selection

The chip template selection is very important. Please consider your design and how many inputs and outputs are needed. There are several templates to choose from and the number of 625 um and 3 mm input/output ports are shown in the page as you select the template need. Currently it is not possible to change chip templates in the middle of a design.



## Placing Components

Simply select the library from which to drag and drop the components and place them into the drawing area. Left click on the T-Switches title bar in the Library Manager to select the library. Figure 68 shows the T-Switch library being selected and the T-Switch being placed into the drawing area. As the T-Switch is being dragged and positioned it appears as outline of dashed lines. Once placed

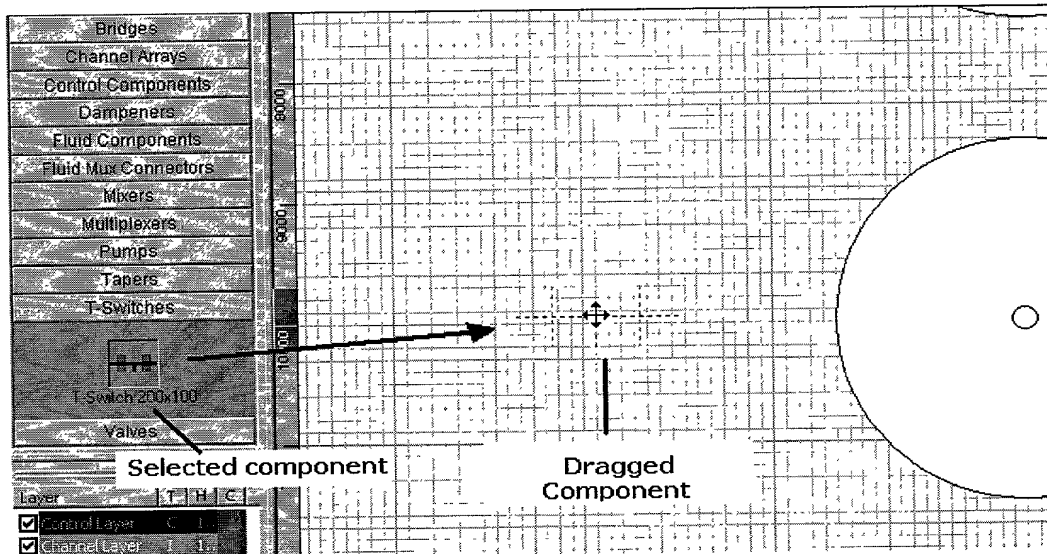


Figure 68 – Placing the T-Switch Component

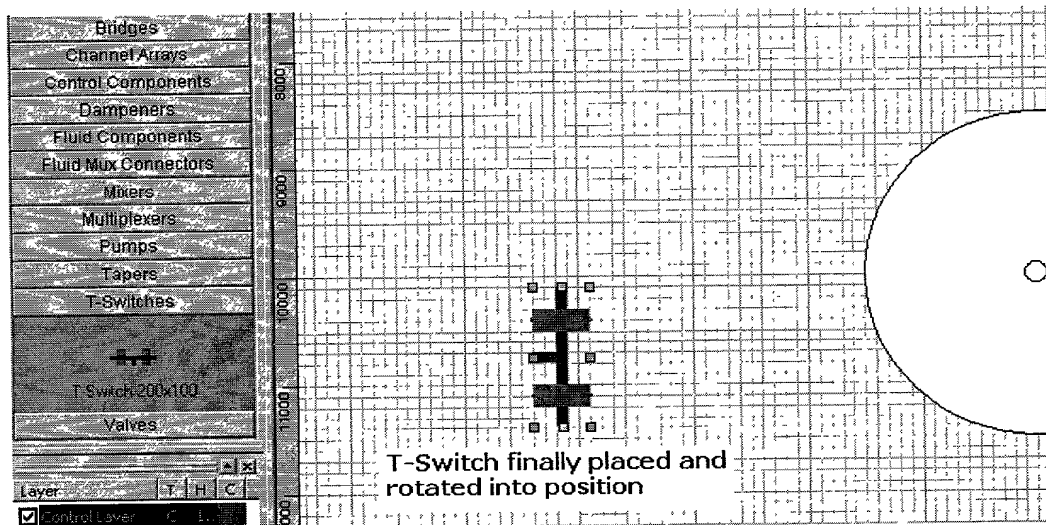


Figure 69 – Finally Placed T-Switch

The placed T-Switch component can now be selected by left clicking it. Once selected, it can be rotated or positioned depending on what is required.

Now, the steps above should be repeated to place the rest of the components for this design.

# Connecting the Components

Once all of the components are placed, they must be connected. The components typically consist of channels from both the fluidic and control layers that are specifically positioned and dimensioned to insure proper operation.

Figure 70 shows the connection of the T-Switch to the “Detection Region”, which consists of two taper elements and a 30 um channel connecting between the two tapers. Recall that to select a component that only has channel in either the fluidic or control layer, the fluidic or control layer must be set “Active”. This can be done in the Layer Manager by left clicking on the desired layer and right clicking to bring up the pop up menu to set the layer “Active” OR this can also be done by right clicking in the drawing area and bring up the pop up menu and selecting *Layer > Control* or *Fluidic*.

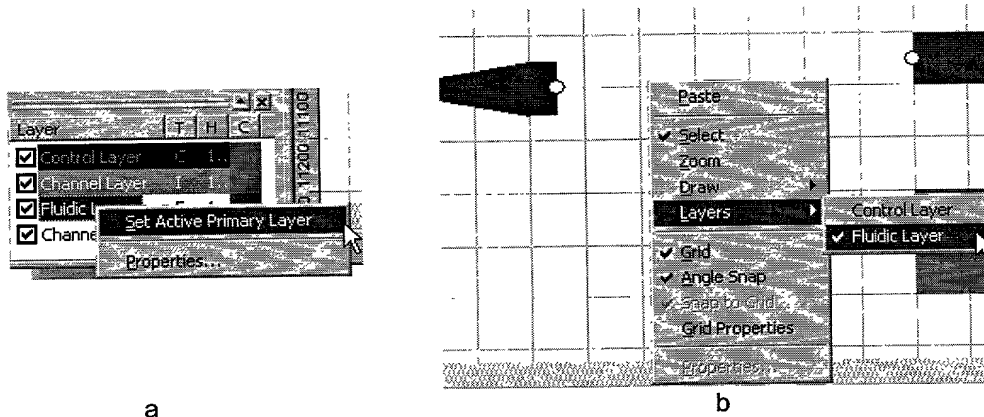


Figure 70. a. Selecting the “Active” Layer through the Layer Manager, b. Selecting the “Active Layer” through the right clicked pop up menu in the drawing area.

In this case the Fluidic Layer needed to be selected as the 30 um – 100 um Taper component was being connected to the input of the T-Switch. Figure 71 shows a channel being drawn from the right end of the Taper component to the input of the T-Switch. Once the cursor turns into the Target Tool a left click will cause a channel to be connected to the unconnected port.

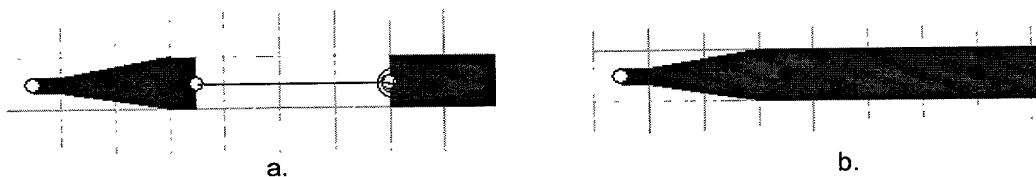


Figure 71 – a. Drawing a Fluidic Connecting Channel, b. Successfully Connected Channel.

# Adding a Vertex While Drawing a Channel

While you are drawing a channel, you can single left click to place a vertex from which you can continue to draw a straight channel or draw the channel orthogonally from the placed vertex. Figure 72 shows an example of how to place a vertex and draw a channel with an orthogonal continuation.





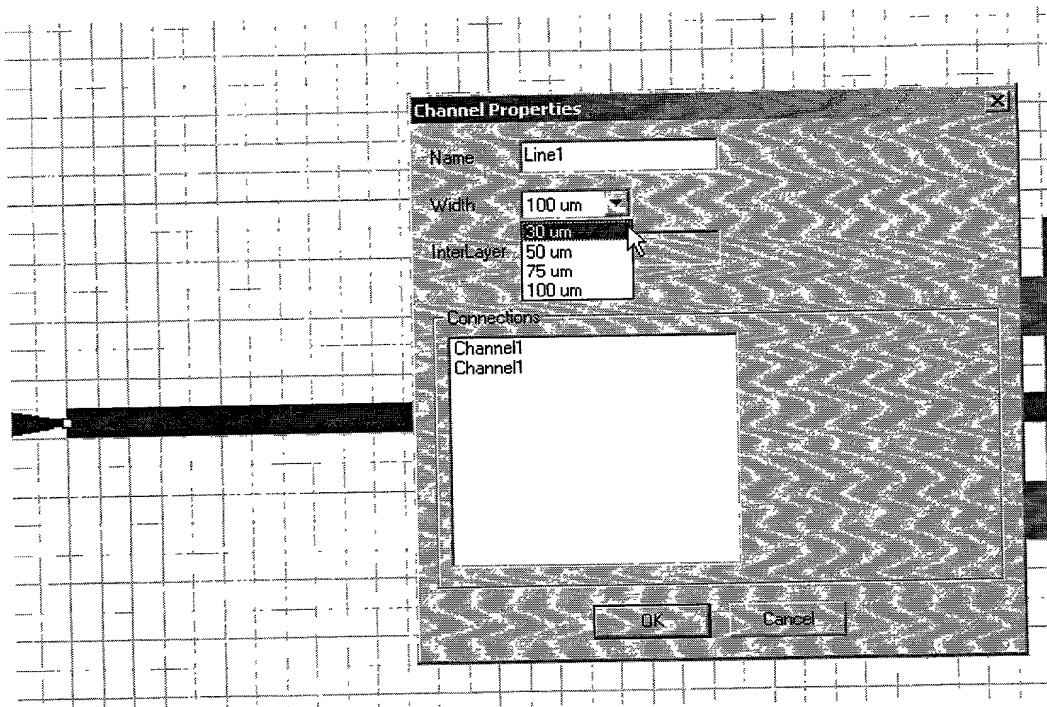


Figure 75 – Setting the Channel Width

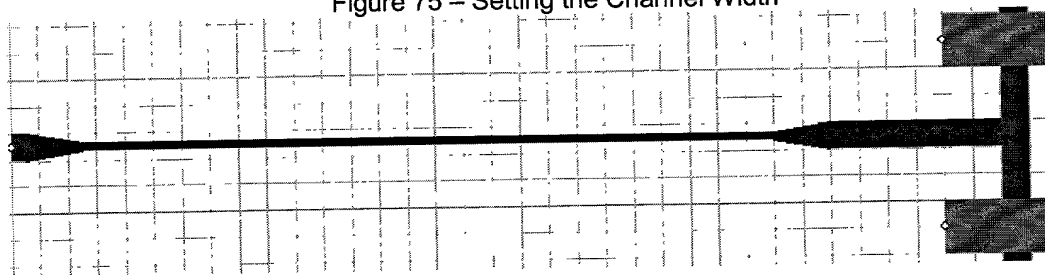


Figure 76 – Drawn Fluidic Channel Width is Now Correct

## Connecting To I/O Ports

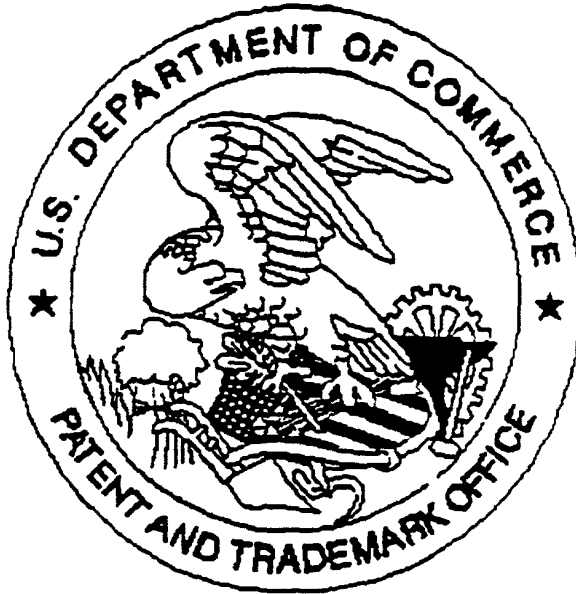
Once all of the components have been interconnected, the inputs and outputs (I/O) need to be connected. They are connected much in the same way that channels are connected with the help of the Target tool. Once the I/O's are successfully connected, the outlined ports will turn from white to black and the port will turn blue as well. Figure 77 shows an example of a successfully connected 625  $\mu\text{m}$  port.





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